North Face Survey
Year 3 Report (2016 - 2017)

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Nevis Landscape Partnership are a Heritage Lottery Funded environmental collective delivering a programme of nineteen projects between 2014 - 2019. The Nevis Partnership are the host organisation for this programme. The Heritage Lottery Fund contribute funding to all nineteen projects.

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The third and final botanical and geological survey of the North Face of Ben Nevis took place between the 8th - 12th August 2016. Building on the success from the previous two years, the Nevis Landscape Partnership and Scottish Natural Heritage continued with a comprehensive and logistically challenging survey of Britain’s highest mountain.

Funding for the project was kindly provided by the Heritage Lottery Fund (HLF) and Scottish Natural Heritage (SNH).

The survey was completed with professional input from the following people and organisations;

Cathy Mayne  Scottish Natural Heritage
Mike Pescod  Abacus Mountain Guides
Roddy Muir, Jenny Ellis, Hugh Barron  Midland Valley Exploration
Alison Austin  John Muir Trust
Ian Strachan  Botanical Expert
Matt Harding  Harding Ecology
Dan Watson  National Trust for Scotland
Robin Clothier  Scottish Mountaineering Club

A major objective of the project has been to raise public awareness of our fascinating and fragile mountain environments and develop working partnerships between professional mountaineers and conservation bodies. Images are reproduced courtesy of the survey team, Nevis Landscape Partnership staff, Murdo MacLeod and volunteers.
SUMMARY

During August 2016, the Nevis Landscape Partnership, in collaboration with our working partners, continued to build on the success of the 2014 and 2015 botanical and geological surveying of the North Face of Ben Nevis. This year marks the third and final survey of this project.

Ben Nevis first attracted botanists and geologists over two-hundred years ago, it has a rich history of scientific and recreational use. However, with the completion of this three-year project it has revealed some of its remaining secrets. The project team made significant discoveries, recording new geological features and arctic-alpine plant species. Midland Valley Exploration have recently confirmed that their Ben Nevis Geology Paper has been peer-reviewed and accepted for publication in the Journal of Geology. The manuscript was reviewed by three respected geologists and some comments are listed below.

“Congratulations on a highly-original and well-written and illustrated paper. It is very rarely that anything so different and original can be said about a classic piece of British geology. You have made a very strong case in dissociating the volcanics from the intrusive complex, suggesting a laccolithic form for the main intrusive complex, and rejecting cauldron subsidence as an intrusive mechanism. I like the very detailed combination of remote sensing, field mapping, and petrology that are interwoven to indicate a completely new interpretation of the Ben Nevis Complex. I have always been suspicious of cauldron subsidence as an intrusive mechanism but always have accepted the original mappers. The paper is a very good read from which I have learned a great deal. It will "ruffle a lot of feathers" but that is healthy in leading to robust discussion. This paper is one of the best that I have read in years."

Professor John F. Dewey
Fellow of the Royal Society, Member of the Royal Irish Academy, Fellow of the Australian Academy of Science, Member of United States National Academy of Sciences, Distinguished Emeritus Professor University of California, Emeritus Professor and Supernumerary Fellow, University College Oxford
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AIMS & OBJECTIVES

AIMS

• IDENTIFY THE BOTANICAL AND GEOLOGICAL FEATURES OF PREVIOUSLY INACCESSIBLE AREAS OF THE NORTH FACE OF BEN NEVIS SSSI.

• BUILD RELATIONSHIPS BETWEEN PROFESSIONALS WORKING IN CONSERVATION & RECREATION.

• DELIVER THREE TECHNICAL SURVEYS OF OVER 125HA OF NORMALLY INACCESSIBLE HABITAT ON THE NORTH FACE OF BRITAIN’S HIGHEST MOUNTAIN

• PRODUCE A CONCISE PROFESSIONAL REPORT WITH USEFUL AND ACCURATE INFORMATION

• GATHER GEOLOGICAL DATA TO BUILD A 3D MAP OF THE BEN NEVIS MASSIF

• PROMOTE AN INNOVATIVE AND EXCITING PROJECT TO AS WIDE AN AUDIENCE AS POSSIBLE; RAISING THE PROFILE OF BEN NEVIS.

OBJECTIVES

• ADVISE SNH, WORKING PARTNERS AND THE PUBLIC OF THE DISTRIBUTION, LOCATION AND CURRENT CONDITION AND OF THESE FEATURES IN DETAIL.

• IMPROVE KNOWLEDGE BASE FOR PROFESSIONAL CLIMBERS, GUIDES, BOTANISTS, GEOLOGISTS AND RECREATIONAL USERS OF THE MOUNTAIN.

• DEVELOP SURVEY SKILLS AND WORKING PRACTICES AS A BLUEPRINT FOR FUTURE SURVEYS ON SIMILAR TERRAIN ELSEWHERE.

• INFORM INTERESTED PARTIES OF THE WORK UNDERTAKEN AND IMPROVE “SITE CONDITION MONITORING”. THUS, HOPEFULLY BRINGING THE UNFAVOURABLE “VASCULAR PLANT” FEATURE INTO FAVOURABLE CONDITION.

• DEVELOP A DETAILED UNDERSTANDING OF THE PROCESSES THAT FORMED THE MOUNTAIN AND PROMOTE THIS TO A WIDER AUDIENCE VIA THE “FIELDMOVE” APPLICATIONS SOFTWARE.

• RAISE AWARENESS OF THE CONSERVATION VALUE OF BEN NEVIS SSSI AND THE PRESSURES PUT UPON IT BY CLIMATE CHANGE AND RECREATIONAL AND COMMERCIAL USE.
PROJECT BACKGROUND & DESCRIPTION

The Ben Nevis Site of Special Scientific Interest (SSSI) is an extensive upland site of 9539 hectares centred on a massif which stretches for over twelve kilometres from Ben Nevis eastwards to Stob Coire na Ceannain. The massif has an altitudinal range from thirty metres above sea level in Glen Nevis to 1344m on the summit of Britain’s highest mountain; Ben Nevis.

The SSSI contains the following features:

- NATIVE PINEWOOD
- FLY ASSEMBLAGE
- SMALL MOUNTAIN RINGLET (EREBIA EPIPHRON)
- BRYOPHYTE ASSEMBLAGE
- BREEDING BIRD ASSEMBLAGE
- UPLAND ASSEMBLAGE
- CALEDONIAN IGNEOUS
- VASCULAR PLANT ASSEMBLAGE
- UPLAND OAK WOODLAND

Reference; SNH SiteLink
FOLLOW LINK FOR FULL DETAILS OF BEN NEVIS SSSI & CONDITION(S)
www.bit.ly/2ffRgWw

NLP and SSSI/SAC whole site

Map of Nevis Landscape Partnership’s project area & the Ben Nevis SSSI/SAC
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PROJECT BACKGROUND & DESCRIPTION (CONT’D)

The range in altitude and geology gives rise to a diversity of habitats including native pine and oak woodlands, montane cliffs, semi-permanent snow beds, upland heaths and grasslands. A wide variety of vascular and lower plants are present. The altitude influences the flora and fauna of the site, further influencing the range of bird and invertebrate species present.

Abandoned climbing equipment gathered from the North Face during the survey.

Ben Nevis and the associated peaks of Aonach Mor and Aonach Beag form a massif that has the highest land in the UK and contains only three peaks greater than 1200m out with the Cairngorms. The SSSI supports an assemblage of upland habitats which includes the only semi-permanent snow beds outside the Cairngorms, and the most extensive scree snow-beds in the UK. The mountain provides unique habitats for rare arctic-alpine flora. The importance of this flora is reflected in the Ben Nevis SSSI feature for vascular plants, currently in “unfavourable” condition.

Some of the key locations that are already known about are at risk from recreational activity but are also potentially further threatened by changing climate. The geological features of the site are unlikely to fall into unfavourable condition, however the detailed geological mapping that Midland Valley undertook in 2014/15 has developed our understanding of the processes that have shaped the mountain.
A significantly greater area of the map below has now been accessed by botanists and geologists. Due to the sensitivity of the site and the guiding designations covering it (NSA, SSSI & SAC) no fixed anchors were placed in the rock.

Image of the Move software interface from Midland Valley Exploration, showing the distribution of the geological data collected during the 2015 survey of the North Face. The coloured discs represent the 3D orientation of geological contacts, joints and faults that were measured using the Fieldmove Clino application. The data have been projected onto a digital elevation model of the Lochaber area. Contours are taken from the Ordnance Survey 1:25,000 dataset. View looking to the south-west with the Halfway Lochan on the right.

Rather than employing heavy duty industrial access techniques (such as placing bolts in the rock) the survey team utilised climbing equipment which can be placed without damaging the site. Many of the sites being accessed were either damp, ‘flush’ areas or along geological contacts. These locations often coincide with large fractures in the rock and consequently are full of loose, wet rock. Climbers usually avoid such places for obvious reasons. The team of mountaineers also brought an extensive and detailed knowledge of the mountain to the scientific survey. Thousands of days guiding clients on the North Face of Ben Nevis gave the geologists and botanists insight into the mountain’s topography as well taking them safely to previously unrecorded areas.
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PROJECT BACKGROUND & DESCRIPTION (CONT’D)

The team used a basic abseil system with two static ropes for safety. The main ‘loaded’ rope had a Rescue 8 with safety prussic, with the second unloaded rope carrying a shunt as a back-up device. Top anchors were constantly overseen by the Nevis Landscape Partnership trainee ranger team to protect surveyors and guides while descending the various cliffs and gullies. More detailed accounts of technical rope access processes are available in Appendix VIII.

TRAINING DAY

As with the previous year, we offered a training day rather than the full week on the first survey year. As the teams consisted of many of the same individuals that had been involved in year one and two, it was felt that this was sufficient and allowed us to manage the budget effectively. The group was split into two, ropes and equipment were positioned at the CIC Hut, surveyors were reminded on the use of the FieldMove application and guides assisted on refreshing abseil technique and equipment use.

TASTER DAY

Some additional funding was sourced in 2016, and from this an additional “survey taster day” was offered for working partners and other environmental organisations on the 4th of August. The idea being to improve wider knowledge of the survey in the local area and offer a unique experience to people who expressed an interest in the ongoing work of the Nevis Landscape Partnership. Invitations were sent out and fourteen people were taken up to the North Face and offered experience of data recording, species identification, geology and a short abseil using the same equipment as the survey team. This was well received with good feedback from the participants. It also provided an extra day’s work for some of the guides to refresh their working practices prior to the ensuing training day and subsequent survey week.

GUIDED WALK & SCHOOL VISIT

Another guided day was arranged for sixth year pupils from Lochaber High School in September after the last survey week. The day was ably assisted by Ali Austin from John Muir Trust and Dan Watson from the National Trust for Scotland. The Nevis Landscape Partnership minibus took everyone up to the Allt a’Mhuilinn from the North Face car park where we discussed the background to the survey and the pupils were shown the various abseil equipment and how it is used by the survey team.
Alan Halewood and a remaining snow patch.
Pupils from Lochaber High School on their field trip to the North Face.
“Taster Day” for employees and volunteers from various environmental organisations.
Alison Austin, John Muir Trust, using Midland Valley’s KlinoMove™ application to record geological contacts.
Everyone then proceeded up to the CIC Hut where we had a chance to look at the data recording methods and discuss the target species and areas covered over a cup of tea. The six girls and their teacher were then given a chance to record data on the FieldMove app. while Ali and Dan took them through some species identification above the CIC Hut on some of the easier ground before returning to the bus in the afternoon.

THE NORTH FACE SURVEY (2016)

During the survey week, many new areas of the north face were surveyed and recorded for the first time finding many new colonies of nationally rare and scarce plant species: in particular saxifrages, grasses and mousear, with additional recording of mosses and liverworts by Gordon Rothero in 2014 and 2015. Besides the huge scale of the task and the challenge of multi-disciplinary surveying on extremely difficult terrain, the survey team had to contend with some challenging weather conditions, complex logistical challenges and the need to physically carry huge amounts of rope, safety equipment and survey items around the mountain each day. At the end of each day the team had to review any issues, gather data, and develop plans for the following day. A detailed table of notable findings and areas worked each day can be found in Appendix VIII.

Every morning was arranged with a 7am meet at the North Face car park, and an 8:20 briefing at the CIC hut. Survey teams were finalised, with key sites identified and access routes determined to manage safety and communications. Each location was allocated specific team members with botanists and geologists allocated as required. The daily logistics were recorded on a rota board at the CIC hut for the communications manager.

Communications and radio checks were continued throughout the day with regular updates on team locations and most importantly managing the hazard of rock fall onto survey teams or the public. Andy Hague and Dave Anderson alternately managed the radio communications from the CIC hut during the survey week in 2016. They facilitated effective communication between team members and monitored public access to the main climbing routes with the aid of a telescope.

The survey was conducted with four teams of two mountaineers either working independently or with a geologist/botanist as a rope of three. Those teams working without expert guidance would carry out a sweep survey of technical terrain, noting indicator species and recording any finds on the FieldMove App. or on notepads. Gordon Rothero unfortunately could not make the 2016 survey and we had the pleasure of welcoming Matt Harding as his replacement. Matt brought some excellent ecological experience of upland habitats to the survey and we thank him for his input at such short notice.
To ensure accuracy of records, digital photos of species were taken (with GPS data recorded and checked) and then checked with the relevant expert back at the base camp at the end of each day. If an area proved of interest, a geologist or botanist would then be taken back to the key areas. This made the best use of resources and maintained a balance between macro and micro-scale surveying.

As with 2015, the 2016 survey had the added input of the NLP’s trainee volunteer rangers (TVR’s), who were deployed to strategic locations where they assisted the survey team in various ways. Belay points were monitored on the summit, 200m bags of rope were moved up and down Ledge Route and along the summit to specific locations and members of the public were informed of activity to avoid the danger of rock fall from the survey teams.

Before entering terrain with a hazard of rock fall the teams would communicate with the base camp officer and other teams to ensure the public were not exposed to any risk. Signage around the area was also used, as were numerous communications during the preceding weeks to the survey on walkers and climber’s forums, blogs and websites. The project was promoted widely on Twitter and Facebook and articles were placed via the following websites and publications:

- Mountain Weather Information Service
- Grough Magazine
- Press & Journal
- UK Climbing
- Mountaineering Council of Scotland
- SNH Nature of Scotland
- The Guardian

After a promising dry start on the Monday and Tuesday, weather conditions deteriorated during the week. The final day produced low cloud and heavy rain and required the team to climb well-above the CIC hut on the Friday morning and afternoon. This allowed a safe crossing of the fast running Allt a’Mhuilinn, assisted by walking poles and a rope at one crossing point. Detailed accounts of the survey work compiled by Ian Strachan, Gordon Rothero and Roddy Muir with their final reports can be found in the appendices at the end of this report.

We invited Murdo Macleod from The Guardian to cover the survey on Thurs. the 11th August. An extra guide was engaged to look after Murdo for the day and unfortunately, he slept in the doorway of the CIC hut after arriving late on the Wednesday evening - the occupants had cautiously locked the hut for the night clearly expecting burglars on the mountain.
THE NORTH FACE SURVEY (2016) (CONT’D)

Despite this, and the deteriorating weather conditions, we thank him for his time and he produced an excellent photo essay and article for the Guardian. The essay, which includes the photographs featured above, can be accessed from the following web link:


CONCLUSIONS

• The survey week completed without any injuries or accidents, which despite all the new discoveries remained our primary consideration. We had much positive feedback from everyone that took part over the course of the three years and it will hopefully remain a memorable and unique experience for all that contributed. There are still some areas that we just could not manage to survey due to time constraints, poor weather and late snow cover. However, it was an experience that set people considering new possibilities for future survey work elsewhere, developing new working partnerships and techniques for site condition monitoring.

• After three weeks of survey work, associated project management and publicity spread over three years, the ecological and geological knowledge of an iconic part of our natural heritage has improved dramatically. The Nevis Landscape Partnership and SNH have demonstrated a unique approach to remote and challenging survey work, incorporating multiple disciplines, working together to achieve a common goal.

• The experience for many of the contractors and participants will hopefully remain an inspiring and motivating factor for future work within their respective professions. An important feature of the Ben Nevis SSSI is now listed as in “Favorable-Maintained” condition due to the more detailed understanding of the distribution of the specific “nationally rare” and “nationally scarce” vascular plants.

• All plant records are to be incorporated into the BSBI Distribution Database, and in due course will be submitted by BSBI to the NBN Atlas Scotland by Ian Strachan.

• Bryophytes (mosses and liverworts) have been recorded and reported on separately by Gordon Rothero.
CONCLUSIONS (CONT’D)

- Environmental knowledge has improved for local mountain guides and this will hopefully be passed on to their client base while on Ben Nevis and other mountains in the area.

- A ‘blueprint’ has been provided for future remote surveys on challenging designated sites, which should reduce the planning work associated with such a potentially labour-intensive process. The skills learnt on this survey should prove useful for future work.

- The profile of Ben Nevis has been raised by the publicity generated by the project with working partners, local businesses and other NGO professionals engaged during the taster day on the north face. Publicity went out through several high-profile organisations including the BBC, Maramedia and The Guardian. Articles were placed with hillwalking magazines, Mountaineering Council of Scotland, Press & Journal, Mountain Weather Information Service, Scottish Natural Heritage’s Nature of Scotland and across various blogs and platforms online and on social media. Several talks have taken place promoting the project with a presentation at the opening night of the Fort William Mountain Festival.

- A peer-reviewed paper has been produced by MVE on the geology of Ben Nevis which, while challenging some established thinking, has been well-received by experienced professionals in this field. It will be published in the Journal of Geology in November 2017.

- The final three years of surveying and associated project management was delivered on time and within the allocated budget to a high standard. Everyone returned from the mountain safely during the surveys with only two recorded minor injuries. Although some ground remained un-surveyed, due to time constraints compounded by poor weather conditions, a much greater area that previously planned has been covered over the three-year timeframe.

- The remaining climbing equipment and unused rope was offered to the Lochaber Mountain Rescue Team who donated funds to the Nevis Landscape Partnership as a gesture of goodwill. These funds will be used to support ongoing conservation work in the immediate area.
APPENDICES

SCOTTISH NATURAL HERITAGE END OF SURVEY REPORT
FINAL BOTANICAL REPORT
GEOLOGY SUMMARY
DIGITAL MAPPING & 3D MODEL BUILDING OF BEN NEVIS IGNEOUS COMPLEX
NOTABLE BRYOPHYTES OB BEN NEVIS, 2015 SURVEY
NATIONALLY RARE & NATIONALLY SCARCE BRYOPHYTES, 2015 SURVEY
NATIONALLY RARE & NATIONALLY SCARCE VASCULAR PLANTS, 2014 SURVEY
MOUNTAIN GUIDING & SAFETY REPORT
SCOTTISH NATURAL HERITAGE SPECIES IDENTIFICATION CARDS
NORTH FACE SURVEY TEAM
The survey took place, much as had been envisaged, over 3 years with survey effort of one week in August 2014, 2015 and 2016. The objective, from SNH’s perspective, was to provide new information on the distribution of the rare arctic-alpine flora found in the Ben Nevis SSSI and specifically on the steep north face of Ben Nevis. This was in the hope that new locations for some of the most restricted species might come to light, and allow a more relaxed approach for current locations where recreational threats exist.

The data delivered during the first two years, coupled with survey from a site condition monitoring report from 2013, allowed SNH to allocate a “Favourable–Maintained” condition to the vascular plant feature for Ben Nevis SSSI. In this the primary objective for SNH for the project was accomplished after only two years.

Further survey in 2016 has brought more populations to light of some of the species sought, with only one species (Saxifraga cernua) still eluding the surveyors. However, the survey in 2017 did complete a detailed count of the one known location for this species and Saxifraga cespitosa, which significantly adds to our store of knowledge. Substantial populations of other species have been recorded, both in extremely inaccessible places and in places which see many people every year. Large numbers of Luzula arcuata were recorded on Observatory Ridge, which sees many ascents by climbers and scramblers every summer. And large populations of Poa flexuosa were counted in the accessible scree fans above the CIC Hut at the foot of the major gullies. Less snow in summer 2016 also allowed exploration of some of the gullies, where snow cover prevented this in 2014 and 2015. However, in almost all cases these areas were not productive for new records.

While a survey of this scale is not envisaged for repeat any time soon, there is now more confidence that the vascular plant assemblage in the Ben Nevis SSSI is in good condition. Some of the techniques might be applicable for searching on the north-east face of Aonach Beag in future surveys; the ground is less steep and therefore more accessible but still requires professional guiding. These techniques have been refined during the north face survey and a pool of well-educated guides created who understand the need to go to the most unlikely places in quest of small but nonetheless highly significant plants. In every way, the Nevis Landscape Partnership has delivered for Scottish Natural Heritage through this project. Our investment has been well-spent and the project has delivered beyond our expectations.

Cathy Mayne
Operations Officer & Ecologist
Scottish Natural Heritage
Introduction & Fieldwork

This report covers the botanical survey carried out over the three years of the North Face Project (NFP), and incorporates the findings from 2016 together with those from 2014 and 2015 as reported in the interim reports. Fieldwork was carried out around the second week of August each year, with one or more training days beforehand. The botanical team comprised Ian Strachan (2014-16), Gordon Rothero (2014-15), Dan Watson, NTS (2015-16) and Matt Harding (2016), with help throughout from Cathy Mayne (SNH). Alison Austin (JMT) and other team members also contributed botanical skills, and Jim McIntosh, BSBI Scottish Officer, joined us for a day in 2014. The core of the survey team was a group of eight professional climbing guides, led by Mike Pescod. A mixture of climbing, scrambling and abseiling was used, as appropriate to the areas being surveyed. In general, each botanist was accompanied by two climbers for safety. A key factor in the success of the project was the climbers’ familiarity with the North Face, not only for safe access, but also for identifying potential survey areas, which often proved to be of high botanical interest. NLP staff organised and supported the project and in 2015-16 their Trainee Volunteer Rangers (TVRs) joined the team. The focus of recording was on Nationally Rare (NR) and Nationally Scarce (NS) vascular plant species, forming part of the Ben Nevis SSSI vascular plant assemblage feature (Table 1).
These are referred to as ‘target species’ in this report. Other notable/indicator species were also recorded when seen e.g. Alpine Saw-wort Saussurea alpina and Moss Campion Silene acaulis, but more general species lists were also compiled as a contribution to the BSBI Atlas 2020 project. Gordon Rothero also recorded bryophytes (mosses and liverworts) in 2014-15 but these have been reported on separately.

Most records were made on iPhones using the Midland Valley FieldMove app, which had been adapted by the geologists working with the team to record both geological and botanical information. The botanists also used handheld GPS units and notebooks. Counts and/or population/habitat extent were also recorded, with associated photographs taken and labelled. Climbing teams surveying without an expert botanist took photographs to confirm plant identifications. On the training days, the botanists carried out introductory or refresher identification work with the climbers and other team members. Laminated ID cards were provided by Cathy Mayne for all the target species.

Map 1 shows the survey area, which comprises the northern and eastern cliffs and slopes of Ben Nevis and Carn Dearg, including Castle Ridge in the north, Coire na Ciste in the centre and Coire Leis in the east. Most of the ridges, buttresses, crags and gullies have been named by climbers over the years and the main ones have been added to Map 1 (pictured below). Details of these and many other climbing routes can be found in the SMC Climbers’ Guide for Ben Nevis and other guides.
Data Analysis

The collated records were imported into GIS for checking against maps and air photos. For ‘Fieldmove’ records, latitude and longitude were converted to OS grid reference. Because of the nature of the terrain on the North Face, considerable difficulties were experienced using GPS units and iPhones, especially in gullies and on steep crags. Some records with obviously incorrect locations could be repositioned manually but others had to be rejected where there was uncertainty. Altitude measurements were also sometimes wrong for the same reasons and were corrected where possible from the OS map. Where available, species photographs were also checked for identification by IS.

The ‘accepted’ records were collated into a single spreadsheet and sorted by species and year. Separate layers were created in GIS for each target species and examined to determine the number of ‘populations’ as defined by SNH for Site Condition Monitoring (SCM) i.e. stands, or clusters of stands, within a 40m radius. Although somewhat arbitrary, this does give an element of consistency. These were compared with previous records from SCM and the BSBI database.

All plant records are to be incorporated into the Botanical Society of Britain & Ireland (BSBI) Distribution Database, and in due course will be submitted by BSBI to the National Biodiversity Network (NBN) Atlas Scotland.

Summary of Survey Findings (2014 - 2016)

During the North Face Survey, the following sixteen species were recorded on the Ben Nevis.

Nationally Rare (6)

- Carex lachenalii         Hare’s-foot Sedge
- Luzula arcuata          Curved Woodrush
- Poa flexuosa            Wavy Meadow-grass
- Saxifraga cemua         Drooping Saxifrage
- Saxifraga cespitosa     Tufted Saxifrage
- Saxifraga rivularis     Highland Saxifrage
Nationally Scarce (10)

- *Athyrium distentifolium*  Alpine Lady-fern
- *Carex saxatilis*  Russet Sedge
- *Cerastium cerastoides*  Starwort Mouse-ear
- *Cerastium nigrescens*  Arctic Mouse-ear
- *Poa alpina*  Alpine Meadow-grass
- *Saxifraga nivalis*  Alpine Saxifrage
- *Sibbaldia procumbens*  Sibbaldia
- *Veronica alpina*  Alpine Speedwell
- *Alchemilla glomerulans*  a Lady’s-mantle
- *Alchemilla wichurae*  a Lady’s-mantle

Map 2 shows the distribution of all records for these sixteen-target species made in each of the three survey years. As expected on Ben Nevis, weather conditions were ‘mixed’ in all three years with frequent mist, rain and wind, and this influenced where survey was carried out to some extent. Late snow-lie was also a limiting factor in the first two years but there was much less in 2016 enabling us to access areas such as Observatory Gully, and over the whole period excellent coverage of the North Face was achieved. A remarkable total of 558 records were made for target species. These are listed, broken down by year, in Table 1. Section 4 gives individual species accounts and distribution maps, highlighting the most important findings. Many other records were made for various other notable species as well as general recording which will contribute to the BSBI Atlas 2020 project.
Table 1.
Nationally Rare (NR) and Nationally Scarce (NS) vascular plant species recorded from Ben Nevis North Face, 2014-16, with number of records for each survey year.

<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>SPECIES NAME</th>
<th>STATUS</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a Lady’s-mantle)</td>
<td>Alchemilla glomerulans</td>
<td>NS</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>(a Lady’s-mantle)</td>
<td>Alchemilla wichurae</td>
<td>NS</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Alpine Lady-fern</td>
<td>Athyrium distentifolium</td>
<td>NS</td>
<td>10</td>
<td>20</td>
<td>27</td>
<td>57</td>
</tr>
<tr>
<td>Hare’s-foot Sedge</td>
<td>Carex lachenalii</td>
<td>NR</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Russet Sedge</td>
<td>Carex saxatilis</td>
<td>NS</td>
<td>19</td>
<td>20</td>
<td>20</td>
<td>59</td>
</tr>
<tr>
<td>Starwort Mouse-ear</td>
<td>Cerastium cerastoides</td>
<td>NS</td>
<td>22</td>
<td>30</td>
<td>49</td>
<td>101</td>
</tr>
<tr>
<td>Arctic Mouse-ear</td>
<td>Cerastium nigrescens</td>
<td>NS</td>
<td>13</td>
<td>15</td>
<td>34</td>
<td>62</td>
</tr>
<tr>
<td>Curved Woodrush</td>
<td>Luzula arcuata</td>
<td>NR</td>
<td>0</td>
<td>9</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Alpine Meadow-grass</td>
<td>Poa alpina</td>
<td>NS</td>
<td>15</td>
<td>7</td>
<td>20</td>
<td>42</td>
</tr>
<tr>
<td>Wavy Meadow-grass</td>
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<td>1</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Drooping Saxifrage</td>
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<td>3</td>
<td>1</td>
<td>4</td>
</tr>
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<td>6</td>
<td>1</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Alpine Saxifrage</td>
<td>Saxifraga nivalis</td>
<td>NS</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Highland Saxifrage</td>
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<td>NR</td>
<td>9</td>
<td>11</td>
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<td>Sibbaldia</td>
<td>Sibbaldia procumbens</td>
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<td>79</td>
</tr>
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<td>Alpine Speedwell</td>
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<td>NS</td>
<td>10</td>
<td>9</td>
<td>24</td>
<td>43</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>138</td>
<td>148</td>
<td>272</td>
<td>558</td>
</tr>
</tbody>
</table>

Table 2 lists the estimated number of ‘populations’ (as defined for SCM) recorded for each target species over the three years, broken down by 1 km grid square (see Map 3). A very large number of populations of target species were mapped (>300), far exceeding expectations. The final column of Table 2 lists the number of sites known prior to 2014 for each species within the project area (mostly based on SCM in 2002 and 2013) for comparison. Several of these figures are underestimates as some sites may include more than one ‘population’. Nevertheless, for most species the project has greatly increased the number of known locations. The altitudinal range of our native flora is a subject of considerable interest to botanists and ecologists, given additional importance with climate change. The altitudinal range of each target species from the North Face Survey has been estimated from the records and using GIS, as listed in Table 3. Comparison with the BSBI spreadsheet of altitudinal ranges indicates that we have established new upper altitudinal limits for Britain & Ireland for eight of the target species, including Tufted and Highland Saxifrages, Alpine and Wavy Meadow-grasses, Arctic and Starwort Mouse-ears, Alpine Lady-fern and the lady’s-mantle Alchemilla glomerulans.
New upper limits have also been found for several other species, such as Mountain Sorrel, Autumn Hawkbit and Stone Bramble (to be confirmed).

Table 2.
Number of ‘populations’ (sensu SCM) recorded for each target species in 2014-16, broken down by 1KM grid square (see Map 3), with number of sites known prior to 2014 within the project area for comparison. In the final column, + indicates a minimum value, as some sites probably include more than one ‘population’. Square brackets indicate pre-1980 records only.

<table>
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<tr>
<th>1KM GRID SQUARE</th>
<th>1571</th>
<th>1572</th>
<th>1671</th>
<th>1672</th>
<th>1771</th>
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<td>5</td>
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<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Carex saxatilis</td>
<td>-</td>
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<tr>
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</tr>
<tr>
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<td>6</td>
<td>14</td>
<td>2</td>
<td>9</td>
<td>34</td>
<td>4+</td>
</tr>
<tr>
<td>Luzula arcuata</td>
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<td>3+</td>
</tr>
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<td>4</td>
<td>-</td>
<td>9</td>
<td>1</td>
</tr>
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<td>Saxifraga cernua</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Saxifraga cespitosa</td>
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<td>4</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>1</td>
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<td>Saxifraga nivalis</td>
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<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>0</td>
</tr>
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<td>Saxifraga rivularis</td>
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<td>4</td>
<td>12</td>
<td>1</td>
<td>-</td>
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<td>4</td>
</tr>
<tr>
<td>Sibbaldia procumbens</td>
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<td>11</td>
<td>57</td>
<td>14+</td>
</tr>
<tr>
<td>Veronica alpina</td>
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<td>5</td>
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<td>44</td>
<td>133</td>
<td>49</td>
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</tr>
</tbody>
</table>

ONE POPULATION EXTENDS INTO NN1772
PLANTS IN GREAT CHIMNEY AREA OF TOWER RIDGE HAVE BEEN CLASSES AS 2 ‘POPULATIONS’
Map 3.
Ben Nevis North Face survey area; OS 1KM grid squares.
Table 3.
Altitudinal range for each target species, as recorded in 2014-16. An asterisk indicates a new upper limit for Great Britain (TBC).

<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>SPECIES NAME</th>
<th>MINIMUM ALTITUDE (M)</th>
<th>MAXIMUM ALTITUDE (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a Lady’s-mantle)</td>
<td><em>Alchemilla glomerulans</em></td>
<td>750</td>
<td>1130*</td>
</tr>
<tr>
<td>(a Lady’s-mantle)</td>
<td><em>Alchemilla wichurae</em></td>
<td>760</td>
<td>970</td>
</tr>
<tr>
<td>Alpine Lady-fern</td>
<td><em>Athyrium distentifolium</em></td>
<td>730</td>
<td>1230*</td>
</tr>
<tr>
<td>Hare’s-foot Sedge</td>
<td><em>Carex lachenalii</em></td>
<td>980</td>
<td>1130</td>
</tr>
<tr>
<td>Russet Sedge</td>
<td><em>Carex saxatilis</em></td>
<td>720</td>
<td>1110</td>
</tr>
<tr>
<td>Starwort Mouse-ear</td>
<td><em>Cerastium cerastoides</em></td>
<td>750</td>
<td>1275*</td>
</tr>
<tr>
<td>Arctic Mouse-ear</td>
<td><em>Cerastium nigrescens</em></td>
<td>810</td>
<td>1270*</td>
</tr>
<tr>
<td>Curved Woodrush</td>
<td><em>Luzula arcuata</em></td>
<td>860</td>
<td>1240</td>
</tr>
<tr>
<td>Alpine Meadow-grass</td>
<td><em>Poa alpina</em></td>
<td>790</td>
<td>1275*</td>
</tr>
<tr>
<td>Wavy Meadow-grass</td>
<td><em>Poa flexuosa</em></td>
<td>800</td>
<td>1214*</td>
</tr>
<tr>
<td>Drooping Saxifrage</td>
<td><em>Saxifraga cernua</em></td>
<td>-</td>
<td>1180</td>
</tr>
<tr>
<td>Tufted Saxifrage</td>
<td><em>Saxifraga cespitosa</em></td>
<td>1024</td>
<td>1250*</td>
</tr>
<tr>
<td>Alpine Saxifrage</td>
<td><em>Saxifraga nivalis</em></td>
<td>1080</td>
<td>1190</td>
</tr>
<tr>
<td>Highland Saxifrage</td>
<td><em>Saxifraga rivularis</em></td>
<td>920</td>
<td>1256*</td>
</tr>
<tr>
<td>Sibbaldia</td>
<td><em>Sibbaldia procumbens</em></td>
<td>700</td>
<td>1310</td>
</tr>
<tr>
<td>Alpine Speedwell</td>
<td><em>Veronica alpina</em></td>
<td>843</td>
<td>1214</td>
</tr>
</tbody>
</table>

Individual Species Accounts

a) Dicots (“Typical” Flowering Plants)

Starwort Mouse-ear *Cerastium cerastoides*  
(NS) (Map 4)

A straggling, mat-forming plant with white flowers that grows on wet acidic scree and rocks, often in areas of late snow-lie. It is usually found above 750 m. Previously known from the tops of No 2, No 4 and South Castle Gullies and from the base of Observatory Gully, during the project it was recorded much more widely across the North Face. Notable populations were found in gullies such as No 5, Observatory and Green Gully as well as many others.
The main concentrations of sites were on Carn Dearg, Coire na Ciste, Observatory Gully and Coire Leis, but it was also recorded on the north side of Castle Ridge and occasionally on the plateau itself. The altitudinal range was from 750m to 1275 m, the latter near the top of No 2 Gully representing a new altitudinal limit for this species in Great Britain.

Map 4.
Records for Starwort Mouse-ea (Cerastium cerastoides) 2014-2016 (Blue Dots)

Arctic Mouse-ea (Cerastium nigrescens) (NS) (Map 5)

This is a patch-forming perennial with large white flowers (formerly known as C. arcticum). It grows on rock ledges and crevices, and in scree. It was previously known from the tops of gullies No 2, 3 and 4 and Coire na Ciste.
During the NFP it was recorded much more widely, including South Castle Gully and the north face of Carn Dearg; No 5 Gully, Trident Buttress, Green Gully and the Comb (Hesperides Ledge); Zero Gully and Coire Leis/Little Brenva Face. Several large populations were found. Altitude ranged from 810m to 1270m at the top of #2 Gully, a new altitudinal record for Great Britain. Arctic Mouse-ear occurs quite widely across the SSSI, which is an important site nationally for this species.

Map 5.
Records for Arctic Mouse-ear (Cerastium nigrescens)
2014-16 (Blue Dots)
FINAL BOTANICAL REPORT (CONT’D)

Drooping Saxifrage *Saxifraga cernua*
(NR) (Map 6)

This is the rarest and perhaps the least conspicuous of the Ben’s arctic-alpines. It grows on tiny crevices and ledges on basic rock. It has distinctive red bulbils on the stems, by which it reproduces. An important population (the second largest of three in the SSSI) occurs on a crag at the top of No 4 Gully where it has been monitored for many years, although it is difficult to count all the plants unaided. A count could not be made in 2013 for SCM due to high winds. Counts were carried out in 2014 and 2016 with rope support; the 2016 survey gave a population of 83 plants. This exceeded the 2002 count of 73 plants and contributed to the ‘favourable’ assessment for the SSSI plant assemblage made in 2016 by SNH. Despite searching, no other sites have yet been found on the North Face.

Alpine Saxifrage *Saxifraga nivalis*
(NS) (Map 6)

The individual rosettes of this scarce plant grow on small ledges and cracks in rock faces. Previously unknown from Ben Nevis itself, in 2014 two populations were discovered on the North Face including 11 plants in Comb Gully/Buttress and two plants on a ledge in No 4 Gully. In 2016 a third plant was found at the No 4 Gully site and a new population of six plants was found around the base of Great Chimney (Observatory Gully/Tower Ridge). This species is known from only seven other sites in the SSSI.
Like Drooping Saxifrage, this rosette plant grows on crevices and ledges on basic rocks, though can expand to form large ‘tufts’. It seems to be declining nationally. A moderate population was already known from the top of #4 Gully, with only one other small population elsewhere in the SSSI. Like the nearby Drooping Saxifrage population, a count could not be made in 2013 for SCM, due to high winds. Counts were carried out in 2014 and 2016 with rope support; the 2016 survey gave a count of 79 plants, more than double the 2002 count of 39 plants.
In addition, several new locations were found for this species during the project. In 2014 eleven plants were found on Hesperides Ledge and nearby on the Comb, also a single plant in #2 Gully; and in 2016 nine plants were found in and below the Great Chimney on Tower Ridge. This is a major increase in the overall population size and, importantly, the number of locations (from two to five) within the SSSI (and nationally) for this rare species, and as with S. cernua contributed to the ‘favourable’ assessment for the SSSI plant assemblage made in 2016 by SNH. Altitude ranged from 1024 m beside Tower Ridge to 1250 m in No 2 Gully, a new altitudinal record for GB.

Map 7
Records for Tufted Saxifrage (Saxifraga cespitosa)
2014-16
Highland Saxifrage (Saxifraga rivularis) (NR) (Map 8)

Highland (or Brook) Saxifrage is a small, often inconspicuous plant with white flowers which grows on wet ledges, but especially in wet flushes on eroding screes with abundant mosses, especially Pohlia wahlenbergii. It was already known from the tops of #2, #3 and #4 Gullies, but proper survey had not been possible because the substrate is so loose and dangerous. Using careful abseil techniques we could conduct more thorough survey in these gullies. Many new locations were also found on the North Face over the survey period, with some substantial populations recorded, for example in No 5 Gully, in Green Gully, on Comb Gully Buttress and the Upper Cascades on Raeburn’s Wall. Altitude ranged from 910m in Observatory Gully to 1256m on Raeburn’s Wall, east of No 2 Gully, a new altitudinal record for GB.

Map 8
Records for Highland Saxifrage (Saxifraga rivularis) 2014-2016
Alpine Speedwell (Veronica alpina)

The dark blue flowers of this mountain plant usually grow on wet rock ledges, stony flushes and scree. Prior to the NFP it was recorded from Coire na Ciste and the top of No 4 Gully. Over the project period 2014-16 many new sites were discovered, with large populations found in No 2, No 5, Observatory and South Castle Gullies, on the Little Brenva Face, in upper Coire Leis, and the largest (>400 plants) on the Comb (Hesperides Ledge). Other new sites include Green Gully, Carn Dearg North Wall and Ledge Route. Elsewhere in the SSSI Alpine speedwell grows on Aonach Beag, Aonach Mor and a few other locations.
Sibbaldia (Sibbaldia procumbens)
(NS) (Map 10)

Sibbaldia is a low-growing plant with distinctive trefoil leaves that grows on fine, base-rich scree including areas of late snow-lie, also on mountain ledges and ridges. It is the most widespread of the target species on Ben Nevis. Previously recorded from the tops of several gullies and the base of Carn Dearg buttresses, many new sites have been found on the North Face during the project. It is especially abundant on Carn Dearg and in Coire Leis/Little Brenva Face, but was also found widely elsewhere in gullies, on ledges and on scree slopes. Altitude ranges from 700m to 1310m near the top of Tower Gully (GB altitudinal limit).

Map 10
Records for Sibbaldia (Sibbaldia procumbens)
2014-16
Various ‘critical’ species of Lady’s-mantle (Alchemilla) occur in Britain, including two Nationally Scarce mountain species that have been recorded previously on Ben Nevis (without detailed grid references). These are A. wichurae, recorded in 1957 from ‘Ben Nevis: slopes near hut’ (presumably the CIC Hut); and A. glomerulans recorded from ‘Coire Leis, Ben Nevis’ in 1947 and ‘Ben Nevis: Allt a Mhuillin’ in 1953. There were no subsequent records for either species. Both are perennial herbs of grassland and rock ledges. In 2016 both species were found on the North Face, thanks to the attentions of Matt Harding and Dan Watson. Alchemilla wichurae was discovered above the CIC Hut near the stream from No 5 Gully and on ledges in Coire na Ciste at the base of South Trident Buttress. Alchemilla glomerulans was found on the north-west face of the Castle at the base of Red Gully, in No 5 Gully, and in Coire na Ciste below No 4 Gully. It was also found on streams to the east of the CIC Hut and on the east side of Coire Leis. Both species could well be more widespread.

Map 11.
Records for Alchemilla glomerulans
Records for Alchemilla wichurae
2014-16.
Individual Species Accounts

b) Monocots (Grasses, Sedges and Rushes) and Ferns

Hare’s-foot Sedge (Carex lachenalia)
(NR)
(Map 12)

This rare, tufted sedge grows on wet mountain ledges. A small population grows near the base of Trident Buttress in Coire na Ciste (42 plants with 12 flowering spikes counted in 2013). In 2016 the original site in Coire na Ciste was resurveyed and 61 plants were counted, including two possible new sub-populations nearby (45% increase on 2013 count). In 2015 a new, much larger population was discovered high up on the east side of Tower Ridge (1130m altitude) with more than 100 flowering plants. Elsewhere in the SSSI there are only two sites known, each with very few plants. These finds represent a major increase in the known population for the SSSI.

Russet Sedge (Carex saxatilis)
(NS)
(Map 12)

This patch-forming sedge grows in high-altitude areas flushed with base-rich water in corries and on rock slabs and ledges. It was already known from sites below Carn Dearg buttresses and in Coire Leis, but many new sites were recorded in 2014-16. The main stands occur to the east and north of Carn Dearg, in Coire Leis and on the Little Brenva Face/Northeast Buttress. One site was found in Observatory Gully but this sedge was not found in Coire na Ciste. Stands were also recorded east of the CIC Hut.
Map 12
Records for Russet Sedge (Carex saxatilis)
Hare’s-foot Sedge (Carex lachenalii)
2014-16

Curved Woodrush (*Luzula arcuate*)
(NR)
(Map 13)

This delicate tufted plant grows on stony plateaus and screes. It is abundant on the summit of Aonach Beag with small patches nearby but, apart from an old record from the north-east of Coire Leis (NN174714, 1972), was not previously known elsewhere in the SSSI. In 2015 a new large, scattered population was found in south-west Coire Leis, the first definite record for Ben Nevis. In 2016 additional sites were discovered on Observatory Ridge and Tower Ridge, in Observatory Gully, and below the Arete at the head of Coire Leis. A single locality on Carn Dearg was also found.
Alpine Meadow-grass (Poa alpine)
(NS)
(Map 14)

Alpine Meadow-grass grows in base-rich rock crevices, ledges, scree and flushes. It nearly always has distinctive proliferating (pseudoviviparous) flowering spikes. It is fairly widespread around the eastern peaks of the SSSI and was known from the tops of several gullies on the North Face, although some counts were known to be incomplete because of access difficulties. In 2014 a very large population (thousands of plants) was found in the upper part of No 5 Gully - possibly the largest population in the UK (GPR). Large stands have also been found in Coire na Ciste, notably on The Comb.
FINAL BOTANICAL REPORT (CONT’D)

Small stands found at several new locations – Raeburn’s Easy Route and Upper Coire Leis. Proper counts have also been made in the other main gullies. The altitudinal range was from 790m to 1275 m, the latter near the top of No 2 Gully representing a new altitudinal limit for this species in Great Britain.

Map 14
Records for Alpine Meadow-grass (Poa alpine)
2014-2016

Wavy Meadow-grass (Poa flexuosa)
(NS)
(Map 15)

Wavy Meadow-grass is a delicate, tufted plant that grows mainly on fine acidic scree in coires and on mountain plateaus. Observatory Gully on Ben Nevis has long been known as the largest of its few populations in Britain.
In 2014 a new population of 95 plants was spotted by one of the project climbers on the Carn Dearg plateau, at the top of a gully on Trident Buttress, with two plants found in 2016 further north. This represents a new altitudinal record for Britain (1214 m). In 2016 a huge scattered population (more than 500 plants/clumps over an area of c. 150 x 100 m), thought to be the largest in Britain, was found on the screes below the Carn Dearg Buttress (at 800-900 m altitude). The Observatory Gully population was also counted in 2016 and had over 300 plants, far more than previous counts, with the population extending for over 200 m up the gully from 808 m to 895m altitude (mapped dots only show limits of this population). There is only one other record for the SSSI, on Aonach Beag (1993).

Map 15
Records for Wavy Meadow-grass (Poa flexuosa)
2014-2016
Alpine Lady-fern (Athyrium distenifolium)
(NS)  
(Map 16)

Alpine Lady-fern grows on acidic rock ledges, gullies, block screes and in shallow hollows where snow lies late. It is plentiful across the SSSI with several scattered populations already known in Coire na Ciste. During the project many new populations were discovered on the North Face. It is particularly abundant in Observatory Gully and Coire Leis, but also on or below the north face of Carn Dearg/South Castle Gully, Zero Gully, the north face of Castle Ridge, Raeburn’s Buttress, Tower Ridge, Orion Face and elsewhere. Altitude ranged from 730m on Castle Ridge to 1230m on Tower Ridge, a new altitude limit for Great Britain.

Map 16
Records for Alpine Lady-fern (Athyrium distenifolium)
2014-2016
BEN NEVIS GEOLOGY SUMMARY (YEAR 3)

AUTHOR(S)               Midland Valley
DATE                   2016

Geological Survey Primary Objectives

- Use Midland Valley’s FieldMove Clino application for smartphones to map out the distribution of the different rock units in the Allt a’Mhuilinn and on the North Face.

- Collect data on the spatial orientation of geological contacts, joints and faults.

- Improve our understanding of how the Ben Nevis area has evolved through geological time.

- Construct a 3D model of the Ben Nevis area in Midland Valley’s Move software that can be shared with the wider community for teaching and research.

Roddy Muir is currently preparing a report on the findings of the geological survey which will be submitted for publication before 2017.

Training Day
Friday 5th August

During the training day Roddy Muir provided a brief overview of our findings from the 2014 and 2015 surveys and reviewed the target areas for the 2016 survey. A refresher session on the FieldMove Clino application was also given to remind participants in the survey best practise techniques for gathering geological and botanical data. Midland Valley provided five iPhone for the climbing teams and at the end of each day the data was downloaded and saved before recharging the phones for the following day.
BEN NEVIS GEOLOGY SUMMARY (YEAR 3) (CONT’D)

Survey Day #1
Monday 8th August

Ascent of NE Buttress with Donald King and Dave Bucket to look for variations or contacts within the volcanic pile. Joint sets were also measured during the ascent. Most of the buttress consists of sedimentary debris flows (Coire na Ciste Formation up to the first platform) and block and ash flow deposits (Summit Formation above the first platform). A thin band of deformed ash-flow tuff occurs just above the forty-foot corner and can be traced laterally to the west for twenty metres. Descent of Tower Gully on foot and via long abseil down the snow slope in Observatory Gully.

Survey Day #2
Tuesday 9th August

Ascent of Castle Ridge with Alan Halewood, Ali Austin and Blair Fyffe. Geological survey along the base of Carn Dearg Buttress, joining Castle Ridge at around 750m above sea level. All the ridge consists of coarse block and ash flow deposits – Summit Formation. Measured orientation of fine-grained ash-flow tuffs between Arch Gully and the top of Ledge Route. Descent to the CIC hut via Ledge Route.

Survey Day #3
Wednesday 10th August


Survey Day #4
Thursday 11th August

Ascent of No.3 Gully with Mike Pescod and Conor Holdsworth to photograph fracture sets in the narrow fault zone that forms No.3 Gully. Searched for minor intrusions and sediments at the edge of the summit plateau and then descended to the CIC hut via Ledge Route.

A big thank you to everyone who made it all possible.
[CLOCKWISE FROM TOP LEFT]
Looking west from North-East Buttress
Lunch time on North East Buttress
Block of porphyritic dacite in Summit Formation
Fine grained ash-flow tuff deposits
Scott Kirkhope at the base of Indicator Wall.
Donald King descending the snow patch in Observatory Gully.
Bedding within fine-grained ash-flow tuffs.
Allt a’ Mhuillin Mudstone Formation and quartzite clasts within the conglomerate layers, Little Brenva Face
Digital Mapping and Three-Dimensional Model Building of the Ben Nevis Igneous Complex, Southwest Highlands, Scotland: New Insights into the Emplacement and Preservation of Postorogenic Magmatism

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ABSTRACT

Caledonian postorogenic magmatic processes are not well understood. New digital mapping and threedimensional modeling of the end-Caledonian (Late Silurian to Early Devonian) Ben Nevis Igneous Complex in the SW Highlands of Scotland provide quantitative estimates of magmatic rock volumes for the first time and argue against local sources for the volcanic rocks or caldera interpretations for structural evolution. Reexamination of the Ben Nevis intrusive Ring Tuff, key evidence for caldera collapse, shows it to be a restricted marginal facies of the monzodioritic Inner Granite, and there is no evidence for a ring fault, previously argued an evidence for caldera subsidence. The volcanic rocks at the core of the complex appear to form a 1.5-km² roof pendant in the Inner Granite, and palaeosol evidence suggests that they had a datolitic source to the NW. Compositional comparisons between the Inner Granite and the monzodioritic Outer Granite indicate that they are unlikely to have a common parentage or be coeval. The plutonic rocks form a consistent, composite, 6.4 × 8.5-km tabular body, elliptical in plan, with a total volume in the range of 44–105 km³. Large areas of late Precambrian Dalradian Supergroup metasedimentary country rocks form parts of a steeply dipping nappe and roof pendant at the edge of the complex. Compositions of calc-alkaline volcanic rocks and plutons of the comparable Comalco San Juan Volcanic Complex in Colorado suggest that the plutonic rocks may have grown as laccoliths during regional caldera volcanism. Structural data suggest that the laccoliths inflated toward the US, fed by NE-SW dikes in the core of the tightly folded Appia Syncline. This reevaluation of a classic area of world geology sheds light on a lost volcanic landscape that once covered much of the SW Highlands of Scotland.

Online enhancements: supplemental PDF

Introduction

Plutonic and volcanic rocks of Late Silurian to Early Devonian age are well exposed in the SW Highlands of Scotland (Fig. 1) and have been the subject of extensive petrographic, geochemical, isotopic, and structural studies for more than a century (e.g., Clough et al. 1908; Bailey and More 1916; Stephens and Halliday 1984; Jacobs and Reavy 1994; Strachan et al. 2002; Neilson et al. 2005). The plutonic rocks, collectively referred to as the Caledonian granites, were emplaced toward the end of the Caledonian Orogeny, after closure of the Iapetus Ocean between Laurentia and Baltica/ Avalonia (Soper 1986; Dewey et al. 2015). Isotopic dating indicates that postorogenic magmatism (e.g., Clemens et al. 2009) began around 454 Ma and persisted for at least 25 Ma from the late Silurian to the Early Devonian (Rogers and Dunning 1991, Oliver et al. 2008, Neilson et al. 2009, Conliffe et al. 2010, Porter and Selby 2010). The plutonic rocks south of the Great Glen Fault, which belong to the Argyll and Northern Highlands Suite of Stephens and Halliday (1984), include a range of rock types from quartz monzodiorite to granodiorite and monzogranite. Many of the plutons are zoned with mafic outer margins and relatively homogeneous central cores of monzogranite. Estimates of the depth of emplacement of the granites range from midcrustal levels (10 km) at Ballachulish to shallow (<5 km), subvolcanic plutons at GlenCoe, Bide, and Ben Nevis (Bailey and Maric 1966; Droop and Treherne 1981; Paterson and Hart 1997; Rokachat and Moore 2004).
The main thrust of this survey has been the search for interesting vascular plants and observations of bryophyte species and communities have been ‘cherry-picked’ during this work. Fortunately, the sites that are of interest for vascular plants are usually good for bryophytes as well but there are some habitats with few vascular plants that have interesting bryophytes, especially where the snow lies very late into the summer. This is a short account of the more important bryophyte communities and species; for a much fuller account of the bryophytes on the Ben Nevis SSSI see Rothero 2005 and 2013. Nomenclature follows Hill et al, 2008.

Where snow lies late into the summer, so-called snowbed communities are widespread on Ben Nevis and the nationally scarce, chionophilous mosses like Northern Haircap (Polytrichastrum sexangulare, Starke's Fork-moss (Kiaeria starkei, Sickle-leaved Fork-moss (Kiaeria falcata), Snow Fork-moss (Kiaeria glaciale), Helmet-moss (Conostomum tetragonum) and Ludwig's Thread-moss (Pohlia ludwigii) are all locally frequent on the more stable patches of finer gravels in the gullies and along the cornice line. In the latter habitat Kiaeria falcata can form very large stands (Photo 1) but mostly these species occur in a bryophyte turf of more common species.

(PHOTO 1) A very large stand of Kiaeria falcata just about the top of Number 3 Gully
There are also important snow-bed liverworts in this habitat including good populations of Alpine Ruffwort (Moerckia blyttii), Snow Threadwort (Pleurocladula albescens) (Photo 2), Speckled Rustwort (Marsupella sphacelata) and particularly, Alpine Jagged Notchwort (Lophozia opacifolia). Where the gravels are a bit drier, especially up on the plateau rim there are scattered stands of Snow Rustwort (Marsupella brevissima), Scarce Silverwort (Anthelia juratzkana), Book Flapwort (Nardia breidleri) and the nationally rare species Compact Rustwort (Marsupella condensata) and Pointed Frostwort (Gymnomitrion apiculatum). One other very rare species, Boeck’s Rustwort (Marsupella boeckii), was recorded from wet rocks in this habitat on Ben Nevis, (the old name for the species was Marsupella nevicensis). I have looked hard for this species in the appropriate habitat during this survey but without success; it has not been seen on the Ben since 1939.

Springs and flushes are also important habitats for bryophytes on the north face as they are for flowering plants, indeed it is the distinctive pale green colour of the larger patches of the moss Mountain Thread-moss (Pohlia wahlenbergii var. glacialis) that has often indicated likely target areas for our survey. Other prominent species here are Pohlia ludwigii and and the much more common Fountain Apple-moss (Philonotis fontana) but mixed with it can be the nationally scarce Spiral Apple-moss (Philonotis seriata). This mix of the common and the rare is the same with the liverworts in the springs, the common Water Earwort (Scapania undulata) is usually accompanied by the montane Marsh Earwort (Scapania uliginosa) and occasionally by the much rarer Floppy Earwort (Scapania paludosa), but they are quite tricky to separate.

A common moss in the springs and flushes is Claw Brook-moss (Hygrohypnum ochraceum) but in a number of places this is accompanied by the rare Soft Brook-moss (Hygrohypnum molle).

This moss has been known for over 100 years from the springs at the top of the Red Burn but this survey has produced several new sites; it is now known from No. 5 Gully in at least two places, at the new Hare’s-foot sedge site on the east side of Tower Ridge (Photo 3) and in two places near the lochan at the head of Coire Leis. In Coire Leis it grows with the rare moss Muehlenbeck’s Thread-moss (Bryum muehlenbeckii) which also occurs in the burn lower down in the coire, and probably elsewhere on the site. Wet crevices associated with the springs but also on wet crags often have the common Dotted Thyme-moss (Rhizomnium punctatum) but occasionally there are patches of the larger, montane species Large-leaf Thyme-moss (Rhizomnium magnifolium).
Much of the north face is composed of crags of hard acid rocks and these have a limited bryophyte flora and the same is true of the areas of scree which are usually too mobile for anything other than the most common species. Prominent here are species of Fringe-moss (Racomitrium) like Bristly Fringe-moss (Racomitrium heterostichum), Slender Fringe-moss (Racomitrium sudeticum), Woolly Fringe-moss (Racomitrium lanuginosum) and Green Mountain Fringe-moss (Racomitrium fasciculare) but there are also occasional stands of the much less common Macoun's Fringe-moss (Racomitrium macounii subsp. alpinum).
The granite mosses, species of Andreaea are also very common; Alpine Rock-moss (Andreaea alpina) is particularly frequent on both solid rock and on gravel, Changeable Rock-moss (Andreaea mutabilis) occurs in some of the burns and the nationally rare Snow Rock-moss (Andreaea nivalis) is locally abundant where there is fairly regular irrigation in areas where the snow lies late (Photo 4). On drier rocks in the areas of latest snow lie there are some shiny, black patches of the very rare Blytt's Rock-moss (Andreaea blyttii), often encrusted with lichen. Other uncommon plants that are quite frequent species on the crags include Arctic Fork-moss (Arctoa fulvella), Alpine Ditrichum (Ditrichum zonatum), Alpine Rustwort (Marsupella alpina) and, where the rock face is often irrigated, the rosy-red threads of Stabler's Rustwort (Marsupellea stableri). One other species to mention here is the nationally scarce moss Gouty-moss (Oedipodium griffithianum) which occurs in sheltered crevices over much of the north face; it is frequent on Tower Ridge, for instance, sometimes in big cushions that look like patches of little lettuces (Photo 5).

More base-rich rocks are harder to find and are usually associated with more broken ground, as at the top of No. 4 Gully, and are often associated with stands of the more interesting flowering plants. Occasionally there are calcicole mosses here like Frizzled Crisp-moss (Tortella tortuosa) and Fine Distichium (Distichium capillaceum) but in general the species are less demanding. Mougeot's Yoke-moss (Amphidium mougeotii) is quite common and its much rarer sister species Lapland Yoke-moss (Amphidium lapponicum) occurs in a few places, particularly in the broken ground at the head of Coire Leis with both Curved woodrush (Luzula arcuata) and Arctic mouse-ear (Cerastium nigrescens). At the top of No 4 gully there is a good stand of Patent Leskea (Pseudoleskea patens) and this species also occurs on the broken crags in the basin to the west of Ledge Route where it occurs with Mueller's Silk-moss (Isopterygiopsis muelleriana).
The more stable areas of scree below the north face are also an important habitat for bryophytes. In the lower scree there is a patchy development of the internationally important liverwort-rich, oceanic-montane heath community. The common species here are Taylor's Flapwort (Mylia taylori), Western Earwort (Scapania gracilis), Lesser Whipwort (Bazzania tricrenata), White Earwort (Diplophyllum albicans), Red Bog-moss (Sphagnum capillifolium) and Woolly fringe-moss (Racomitrium lanuginosum) and the globally rare and disjunct liverwort Donn's Notchwort (Anastrophyllum donnianum) is locally frequent. The other characteristic species of this community at this altitude, Cloud Earwort (Scapania nimbosa) and Birds-foot Earwort (Scapania ornithopodioides) are surprisingly uncommon given their frequency elsewhere on the Ben Nevis SSSI. Though some of these big liverworts are reasonably common in the north-west of Scotland, most are very rare in Europe and some have their only European sites here.
Other rare species are associated with crevices in the scree, usually where there is some build-up of litter from the Alpine Lady fern; the most frequent of these are Snow Feather-moss (*Sciuro-hypnum glaciale*) and Reflexed Feather-moss (*Sciuro-hypnum reflexum*), often occurring with Shaded Wood-moss (*Hylocomiastrum umbratum*) and Downy Plait-moss (*Hypnum callichromum*). Both occur with the fern in Coire Leis and Coire na Ciste and *Sciuro-hypnum glaciale* has other stands in broken ground on the side of Tower Ridge, at the top of No. 4 Gully and on the west side of Ledge Route and certainly elsewhere. Other notable species that occur in the interstices of the scree are Muhlenbeck's Feather-moss (*Herzogiella striatella*), Greater Pawwort (*Barbilophozia lycopodioides*), Obtuse Notchwort (*Lophozia obtusa*) and Alpine Earwort (*Diplophyllum taxifolium*). 

**REFERENCES**


NATIONALLY RARE & NATIONALLY SCARCE BRYOPHYES
RECORDED FROM THE NORTH FACE OF BEN NEVIS

Nationally rare species (taxa) are underlined. All species included in the list have been seen on the site since 1985 except Marsupella boeckii and almost all have been seen during the current survey. Taken from lists of nationally rare and scarce by Preston (2006 and 2010).

Mosses (28 taxa)
Amphidium lapponicum
Andreaea blyttii
Andreaea mutabilis
Andreaea nivalis
Arctoa fulvella
Bryum muehlenbeckii
Conostomum tetragonum
Dicranodontium asperulum
Dicranodontium uncinatum
Dicranoweisia crispula
Ditrichum zonatum
Herzogiella striatella
Hygrohypnum molle
Isopterygiopsis muelleriana
Kiaeria falcata
Kiaeria glaciale
Kiaeria starkei
Oedipodium griffithianum
Philonotis seriata
Philonotis tomentella
Pohlia ludwigii
Pohlia wahlenbergii var. glacialis
Polytricha strum sexangulare
Pseudoleskea patens
Racomitrium macounii subsp. alpinum
Rhizomnium magnifolium
Sciuro-hypnum glaciale
Sciuro-hypnum reflexum
Liverworts (24 taxa)
Anastrophyllum donnianum
Anthelia juratzkana
Barbilophozia lycopodioides
Diplophyllum taxifolium
Gymnomitrion apiculatum
Haplonitrium hookeri
Harpanthus flotovianus
Lophozia obtusifolia
Lophozia opacifolia
Marsupella adusta
Marsupella alpina
Marsupella boeckii
Marsupella brevissima
Marsupella condensata
Marsupella sphacelata
Marsupella stableri
Moerckia blyttii
Nardia breidleri
Pleurocladula albescens
Scapania aequiloba
Scapania nimbosa
### Nationally Rare & Nationally Scarce Bryophytes Table 1.

**Nationally Rare** and Nationally Scarce vascular plant species recorded from Ben Nevis North Face, August 2014. *species not previously recorded on Ben Nevis.

<table>
<thead>
<tr>
<th>SPECIES NAME</th>
<th>COMMON NAME</th>
<th>AUGUST 2014 FINDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athyrium distentifolium</td>
<td>Alpine Lady-fern</td>
<td>Found at several new locations.</td>
</tr>
<tr>
<td>Carex lachenalii</td>
<td>Hare’s-foot Sedge</td>
<td>Known site at base of Trident Buttress counted and wider area explored.</td>
</tr>
<tr>
<td>Carex saxatilis</td>
<td>Russet Sedge</td>
<td>Several new and large populations found e.g. North-east Buttress, Observatory Gully, Carn Dearg Buttress.</td>
</tr>
<tr>
<td>Cerastium nigrescens</td>
<td>Arctic Mouse-ear</td>
<td>Small stands found at several new locations e.g. No 5 Gully, Little Brenva Face, Hesperides ledge/Comb Buttress.</td>
</tr>
<tr>
<td>Cerastium cerastoides</td>
<td>Starwort Mouse-ear</td>
<td>Found at several new locations e.g No 5 Gully, Comb Gully Buttress.</td>
</tr>
<tr>
<td>Poa alpina</td>
<td>Alpine Meadow-grass</td>
<td>Found at several new locations including exceptional population (000’s) in upper part of No 5 Gully – possibly largest population in UK?</td>
</tr>
<tr>
<td>Poa flexuosa</td>
<td>Wavy Meadow-grass</td>
<td>2 significant new populations found, one ca 100m below existing stand in Observatory Gully, another ca 1 km away at top of gully on Trident Buttress (new UK altitudinal record).</td>
</tr>
<tr>
<td>Saxifraga cernua</td>
<td>Drooping Saxifrage</td>
<td>Count made of known population at top of No 4 Gully (not counted since 2002)</td>
</tr>
<tr>
<td>Saxifraga cespitosa</td>
<td>Tufted Saxifrage</td>
<td>Count made of known population at top of No 4 Gully (not counted since 2002), also 2 new locations found, including 11 plants on ledges in Comb Gully/Buttress, and a single plant in No 2 Gully.</td>
</tr>
<tr>
<td>Saxifraga nivalis*</td>
<td>Alpine Saxifrage</td>
<td>2 new populations found (first records from Ben Nevis), including 11 plants on ledges in Comb Gully/Buttress, and 2 plants on ledge in No 4 Gully.</td>
</tr>
<tr>
<td>Saxifraga rivularis</td>
<td>Highland Saxifrage</td>
<td>Presence confirmed, and counts made in Number 2, Number 3 &amp; Number 4 gullies. Large new population in Number 5 Gully, also at several new sites.</td>
</tr>
<tr>
<td>Sibbaldia procumbens</td>
<td>Sibbaldia</td>
<td>Found at many new locations across the North Face e.g. Comb Gully Buttress, Little Brenva Face, Central Gully.</td>
</tr>
<tr>
<td>Veronica alpina</td>
<td>Alpine Speedwell</td>
<td>Found at several new locations including exceptional population of several hundred shoots on Hesperides Ledge (Comb Buttress), also Number 5 Gully, Ledge Route, South Castle Gully.</td>
</tr>
</tbody>
</table>
MOUNTAIN GUIDING AND SAFETY REPORT
NORTH FACE SURVEY 2016

The final training days and week of surveying were managed safely and effectively by a well-practiced team of guides. No injuries were incurred, and a total of twenty-five people were safely deployed in some very testing weather. Guiding techniques were further refined resulting in greater efficiency allowing more areas to be surveyed, and less rope being used and worn out. Members of the public seemed to be aware of the survey and were very happy to consider the operations of the survey teams in their own activities.

Taster Day 4th August 2016
This was a new addition to the work of the survey. Fourteen guests from Nevis Landscape Partnership’s associate organisations were invited to a day on the North Face of Ben Nevis to learn and experience first-hand what is involved in the survey. The group went to the CIC Hut and had an overview of the botanical and geological work carried out so far as well as the type of access techniques used, and scale of operation required in the project. The guests then had the opportunity to spend 90 minutes with our expert botanists, geologists and to try an abseil on one of the smaller cliffs close to the CIC Hut. This was all very well received by the guests who went away informed and enthused by the work that has been carried out and the possibilities this type of project opens up in their own organisations. The day was made extra special by the discovery of a large and previously unrecorded population of Wavy Meadow Grass.

Training Day 5th August 2016
To achieve the objectives of this day (to remind the guides how to use the IPhone App Field Move Clino, to refresh the guides recognition of the target species of plants and to refresh the experts’ techniques in abseiling) the group was split in two after using the App near the CIC Hut. One group went to look at botany including a count of the Wavy Meadow Grass in the Number Five Gully Screes (500 plants) while the other group set up and abseiled down the Organ Pipes wall. During the abseil, guides helped the experts on a parallel line. Each expert (Cathy Mayne, Ian Strachan, Dan Watson, Blair Fyffe and Alison Austin) was reminded how to lock off the rescue 8 descender and release it again, how to release a loaded shunt on the second rope and details such as setting the length of cow’s tails. Volunteer guide James Cooper was also observed in these techniques and presented himself to be very competent. Five bags of 200m static ropes, two bags of 100m static ropes and many dynamic ropes and hardware were carried to the hut in readiness for the survey.
Survey Week 8th to 12th August 2016

Each day started at 7am prompt at North Face Car Park in Torlundy. Several vehicles were used to drive through the forest to the top car park (having extra vehicles available for evacuation can be useful). The morning meeting was at 8.20am each day with teams and locations being allocated. All these details were recorded on a board in the CIC Hut with potential conflicts being noted. Radios and iPhones were issued as well as ropes and equipment. CIC Hut communications were managed by Andy Hague or Dave Anderson. This is a vital role that allows for communication with the public, communication between teams and updates on progress. Having two or three radio frequencies was useful to minimise confusing radio traffic. Properly waterproof radios would be advantageous as well. Moving ropes to the correct location was mostly done by the Trainee Volunteer Rangers (TVR’s) who were excellent in this work and in guarding the anchors on the plateau. Our thanks go to Hannah Bathgate, Beccy Cantle, Peter Struthers and Ciaran Tangney along with Lewis Pate and Susan Nicol. If ropes are in place at the start of the day, the team using them can get on with the survey work much more quickly. The teams came back together at the CIC Hut for about 4pm (often later) for a meeting to discuss findings and choose areas of work for the following day. The weather was cold but dry and clear on the first two days, wet and cloudy on days three and four, very windy, wet and cloudy on the last day.
<table>
<thead>
<tr>
<th>DATE</th>
<th>GROUP DETAILS</th>
<th>WORK AREAS</th>
<th>NOTABLE FINDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Mike, James, Ian, Lewis, Hannah, Peter</td>
<td>Up Ledge Route with 3 bags of 200m ropes to Green Gully. Mike, James and Ian abseiled Green Gully – the rope on the first drop was pulled back to the summit by Peter, Hannah and Lewis. A second rope was used for two further abseils to the bottom of the gully. Lewis, Hannah and Peter stowed the ropes and descended Ledge Route.</td>
<td>Highland Saxifrage, Starwort Mouse Ear, Arctic Mouse Ear, Alpine Speedwell, Alpine Meadow Grass</td>
</tr>
<tr>
<td></td>
<td>Alan, Connor, Will</td>
<td>Fixed a static rope (100m) in Observatory Gully narrows to protect travel up and down the snow slope.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Scott, Dan, Matt, Cathy, Dave A, Beccy</td>
<td>Made a count of the Observatory Gully Wavy Meadow Grass</td>
<td>Wavy Meadow Grass</td>
</tr>
<tr>
<td></td>
<td>Scott, Will, Dan, Alan, Connor, Matt</td>
<td>Observatory Gully up to the foot of Point Five Gully, the base of Tower Scoop and the flank of Tower Ridge down to the foot of The Great Chimney</td>
<td>Curved Woodrush, Arctic Mouse Ear, Starwort Mouse Ear, Alpine Speedwell, Alpine Meadow Grass, Tufted Saxifrage</td>
</tr>
<tr>
<td></td>
<td>Dave A, Cathy, Beccy</td>
<td>Orion &amp; Zero Gully bowl</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Donald, Dave B, Roddy</td>
<td>North-East Buttress with diversions onto Little Brenva Face, down Tower Gully and Observatory Gully</td>
<td>N/A</td>
</tr>
<tr>
<td>DATE</td>
<td>GROUP DETAILS</td>
<td>WORK AREAS</td>
<td>NOTABLE FINDINGS</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tuesday</td>
<td>Donald, Will, Ian, Susan, Peter,</td>
<td>Carried two bags of 200m static ropes up Ledge Route to the top of Number Two</td>
<td>Highland Saxifrage&lt;br&gt;Arctic Mouse Ear&lt;br&gt;Starwort Mouse Ear&lt;br&gt;Generally acidic environment with little of interest.</td>
</tr>
<tr>
<td>09/08/2017</td>
<td>Beccy, Hannah</td>
<td>Gully. On inspection by Donald, the gully was judged to be too loose to descend. Instead, two 200m ropes were fixed down Comb Gully Buttress to the foot of Number Two Gully. The lower reaches of the gully and the base of The Cascade were surveyed. Will and Peter pulled the two ropes back to the top and descended Ledge Route while Susan, Beccy and Hannah carried two bags of 200m ropes to the summit and descended Coire Leis.</td>
<td>Big population of Alpine Speedwell and an as-yet unidentified grass discovered by Cathy.</td>
</tr>
<tr>
<td></td>
<td>Scott, Andy, Matt</td>
<td>Explored Little Brenva Face from North-East Buttress reaching about 150in, as far as Route Major.</td>
<td>Tufted Saxifrage&lt;br&gt;Alpine Saxifrage&lt;br&gt;Arctic Mouse Ear&lt;br&gt;Alpine Speedwell&lt;br&gt;Alpine Meadow Grass&lt;br&gt;Oak Fern</td>
</tr>
<tr>
<td></td>
<td>Dave B, Cathy, James</td>
<td>Explored Little Brenva Face from the left. No easy access was found onto the face without abseiling, but the furthest left buttress was investigated.</td>
<td></td>
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<tr>
<td></td>
<td>Mike, Connor, Dan</td>
<td>Carried a second 100m rope up Observatory Gully to the narrows. The foot of The Great Chimney was inspected more closely, and it was decided to abseil the chimney on another day. Girdle Traverse Ledge under Indicator Wall to the edge of Point Five Gully within 10m.</td>
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<td>DATE</td>
<td>GROUP DETAILS</td>
<td>WORK AREAS</td>
<td>NOTABLE FINDINGS</td>
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<tr>
<td>Wednesday</td>
<td>Alan, Roddy, Ali, Blair</td>
<td>Castle Ridge with deviations left and right.</td>
<td>Generally acidic environment with little of interest.</td>
</tr>
<tr>
<td>10/08/2017</td>
<td>Scott, Will, Roddy</td>
<td>Base of Little Brenva Face, over summit, down to Tower Gully to Girdle Traverse Ledge under Indicator Wall. Fixed ropes (2 x 100m) were taken down and placed at the foot of Tower Ridge.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Donald, Connor, Matt, Peter, Hannah, Beccy</td>
<td>The Castle from the top. Abseil in 100m and jumar/hoist back out. Ropes were bagged and taken down west flank of Carn Dearg to Allt a’ Mhuillin.</td>
<td>Nothing very exciting but would be worth looking at The Castle from the bottom to the base of the summit crags.</td>
</tr>
<tr>
<td></td>
<td>Dave B, Dave A, Dan, Ali</td>
<td>Count of saxifrages at known location in Number Four Gully.</td>
<td>The number of Drooping and Tufted saxifrages is greater than in previous years.</td>
</tr>
<tr>
<td></td>
<td>Alan, Ian, James, Mike, Cathy, Blair</td>
<td>Down Observatory Ridge and Hadrian’s Wall to Girdle Traverse Ledge on fixed ropes. Short rope to explore the traverse ledge. Climb back up Observatory Ridge.</td>
<td>Curved Woodrush on Hadrian’s Wall (to the right of Observatory Ridge) and on the crest of Observatory Ridge. Also, Alpine Lady Fern and Oak Fern.</td>
</tr>
<tr>
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<tr>
<td>Thursday 11/08/2017</td>
<td>Scott, James, Dan, Murdo, Iain M</td>
<td>Up Tower Ridge with 2 x 100m ropes. Abseil The Great Chimney. Iain M, Dan, Murdo descended whilst Scott and James pulled the ropes back to the crest of Tower Ridge.</td>
<td>Curved Woodrush on the crest of Tower Ridge at the top of The Great Chimney. Seven more Tufted saxifrage and five more Alpine saxifrage at the foot of the chimney.</td>
</tr>
<tr>
<td></td>
<td>Donald, Cathy</td>
<td>Revisit site of unidentified grass discovered by Cathy earlier in the week at the foot of Little Brenva Face.</td>
<td>Russet Sedge Alpine Lady Fern Beach Fern</td>
</tr>
<tr>
<td></td>
<td>Alan, Ali, Blair</td>
<td>Tower Cleft for geological readings.</td>
<td>Nothing growing at all.</td>
</tr>
<tr>
<td></td>
<td>Mike, Roddy, Connor</td>
<td>Up Number Three Gully. Mike went to help TVR’s carry ropes and Connor and Roddy searched for a tuff on Carn Dearg before descending Ledge Route.</td>
<td>Site of fault shift direction indicator cracks located, cleaned and photographed. Also, Highland saxifrage in abundance, Arctic and Starwort Mouse Ear.</td>
</tr>
<tr>
<td></td>
<td>Will, Ian</td>
<td>Flank of Carn Mor Dearg arete from Abseil Posts leftwards, away from Ben Nevis.</td>
<td>Curved Woodrush Alpine Lady Fern Alpine Saw Wort Arctic Mouse Ear Alpine Speedwell Sibbaldia</td>
</tr>
<tr>
<td></td>
<td>Dave B, Matt</td>
<td>Number Five Gully upper slopes from Ledge Route.</td>
<td>Highland Saxifrage, Alpine Speedwell, Alpine Lady Fern Sibbaldia, Three Flowered Rush, Two Flowered Rush</td>
</tr>
<tr>
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<tr>
<td></td>
<td>Andy, Susan, Beccy, Hannah, Ciaran</td>
<td>Went to the summit via Coire Leis to collect three bags of 200m ropes. These were carried with a little help from Mike later down past Lochan Meall an t’Suidhe to top car park.</td>
<td>N/A</td>
</tr>
<tr>
<td>Friday</td>
<td>Cathy, Roddy, Lewis</td>
<td>Descended due to unfavourable conditions. Number Four Gully to finish count of saxifrages. It was too windy to reach the Wavy Meadow Grass location on Carn Dearg.</td>
<td>N/A</td>
</tr>
<tr>
<td>12/08/2017</td>
<td>Scott, Dave B, Matt</td>
<td></td>
<td>More Tufted Saxifrage counted as well as three Alpine Saxifrage at location found in 2014. Also, Rock Ladies Mantle at Right Hnad Gulch of Coire na Ciste.</td>
</tr>
<tr>
<td></td>
<td>Mike, Matt, Will</td>
<td>Base of Trident Buttresses, known location of Hare’s Foot Sedge.</td>
<td>Count of Hare’s Foot Sedge greater than previous years and found in new location close by. Also, Alpine Meadow Grass, Alpine Speedwell and Arctic Mouse Ear.</td>
</tr>
<tr>
<td></td>
<td>Dave A, Connor, Ian, Hannah, Beccy, Ciaran</td>
<td>Further count of Wavy Meadow Grass in Number Five Gully screees.</td>
<td>Another 48 plants counted. Also, an unknown plant was found and awaits identification.</td>
</tr>
<tr>
<td></td>
<td>Andy, James</td>
<td>Sorted and tidied gear at CIC Hut.</td>
<td></td>
</tr>
<tr>
<td>DATE</td>
<td>GROUP DETAILS</td>
<td>WORK AREAS</td>
<td>NOTABLE FINDINGS</td>
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<tr>
<td></td>
<td>Donald, Alan</td>
<td>Retrieved two 100m ropes from Tower Ridge and rigged rope required to cross the Allt a’ Mhuillin 100m above the CIC Hut due to rain and strong wind.</td>
<td>N/A</td>
</tr>
</tbody>
</table>
All the big abseils were made with two static ropes; one was the main line with rescue 8 and prussic if required, the other was unloaded with a shunt for back-up. Retrievable abseils were possible and speeded up the survey process dramatically but also relied on the experts being able to solve simple problems if they were to arise.

Knowledge of the climbs was invaluable to determine the best places to anchor the ropes in a safe place protected from rock fall. Longer drops (more than 90m or so) were less secure due to the increased hazard of movement (pinging) of the loaded rope above, causing rock fall and resulting in a swing on the ropes.

Every time, a guide was at the top anchors with a VT prussic to allow descending a loaded rope to affect a rescue if required. This guide also had a mini traction in order to hoist the expert/guide back up the crag if required. Neither of these was required but did give another element of security to the experts.

A combination of abseiling (one guide to set ropes and one expert to follow) to access areas followed by hoisting expert and guide by assistant guide and other people at the top seems to be a good option.

Normal Alpine style guiding, and rope work was used in many situations on easier ground. On Hadrian’s Wall, a long multi pitch abseil was used first followed by short roping on the girdle traverse ledge. Being able to use a variety of techniques and to choose and adapt them according to the situation found on the day was very useful. The adaptability and judgment making of the guides is highly commended. Jumaring a long way up ropes on awkward ground is not recommended to anyone except an experienced guide.

Pressure was felt by guides when setting up abseils when there were several people waiting in poor conditions on the plateau. The TVR’s were very helpful in moving rope to the right places and in guarding the anchors at the top but they were also a factor in the decision making of the guides who did not want to leave them exposed for any longer than absolutely required.

Rock fall was kept to a minimum and was managed most of the time. In the case of ropes moving unexpectedly during an abseil, rock fall was encountered. Keeping the abseils shorter would help reduce the chance of this occurring. In another situation, a short climb was required by the guide back on to Tower Ridge up a recorded winter route. It turned out to be unclimbable and a rope was fixed for the guide to jumar up. This caused some rock fall. Fixing ropes for ascent on sections of ground without first inspecting the rock was not the common practice during this survey and this incident is a good reminder of the hazards involved. Abseiling first to clear loose rock followed by ascending ropes set in place there is less of a problem.
The other main hazard encountered was moving block scree due to the very wet conditions experienced over the last few weeks. On one occasion one of the TVR’s found herself on a moving area of blocks that could have caused entrapment of a limb. Similar but less serious areas of rock were found in Coire Leis as well.

AREAS STILL TO BE SURVEYED ON BEN NEVIS
Due to the bad weather on the last day we did not manage to reach the central grass bands on the Little Brenva Face in Coire Leis. These can be accessed by a short abseil from the left of the face (CMD Arête side).

Vanishing Gully and Italian Climb on the West Flank of Tower Ridge will be worth exploring by abseil from the crest of Tower Ridge.

The Castle from its base, accessed from South Castle Gully.

The Basin on Orion Face. With poor weather this year it was decided that the investment in time, the effort required, and risk involved were not worth the rewards of going to The Basin. This will be best achieved by climbing The Long Climb. Cathy Mayne and Dan Watson are both very capable of doing this at an opportune moment after a couple of weeks of dry weather.

All these areas could be accessed in another one-week survey including The Basin with a top down, abseil approach.

RECOMMENDATIONS FOR FUTURE SURVEYS
At least one planning day with key botanists and mountain guides is essential.

Include at least one training day with all botanists, geologists and guides. This will include carrying equipment to the site, botany and geology refreshers as well as further coaching for the experts. If experts are involved with little or no experience in this type of work more training is likely to be required.

Using the experts and guides from this survey will make future surveys much easier and most effective. The rope techniques used have been developed over the three years of this survey and are different to what was thought of initially.

Keep the number of surveyors the same, one expert with two guides (or one guide and one high standard assistant). There is much security in having other teams of guides/experts close by. Also, the work load is quite demanding, but this can be managed by rotating guides through different jobs if there are a few teams of guides and experts.

Ensure that media teams have their own guides and that they are aware of what they can achieve so as not to disrupt the survey too much.
We should continue not to be prescriptive with techniques and their detail. Mountaineering will continue to demand a flexible approach and the most valuable skill is that of making good judgments in advance and on the spot. The team of guides showed they are able to make good judgments throughout this survey and the feedback from the experts demonstrated this.

**SUMMARY**

Continuity of geological and botanical experts and guides was a key factor in the success of this survey. As the experts gained confidence and competence in their rope skills, the techniques used by the guides were adapted to be able to reach more difficult places much more quickly. Techniques were developed to allow for safe access to very difficult places in a short space of time. These techniques were a combination of those from mountaineering, IRATA and mountain rescue. The most effective methods of access by abseil were not those anticipated before we began. Techniques evolved during the three years.

The result is a team of botanists, geologists and guides with the skills and working relationship to perform similar surveys in other areas. Simply by accessing the most difficult parts of Ben Nevis North Face, this survey has helped the SSSI vascular assemblage be reclassified from unfavourable to favourable condition.

The wider benefits of this survey must also be emphasised. The team of eight guides are now landscape champions who will reach out to very many visitors, climbers and instructors to tell them the story of the Ben Nevis environment. Being part of this survey has given us great knowledge and understanding of the nature of this landscape and will inspire us to educate others.

This survey has also made strong connections between climbers and ecologists. The climbers have learned so much from the botanists, but the botanists have also learned a great deal from climbers. There is a very high mutual respect for each other and a shared passion for Ben Nevis. It is clear that climbers are not the cause of any problem to the health of the vascular plants; to the contrary, it is only with the help of climbers that this survey was possible, and the climbers have understood the importance of the plants.

When we walk in to Coire na Ciste in the future we will tell our clients about the biggest known population of Wavy Meadow Grass in the UK in the scree below Number Five Gully which are crossed by the main path. As we climb Green Gully, what was the hardest ice climb in the world for about 20 years, first climbed by Harrold Raeburn over a century ago, we will tell our clients of the Mouse Ears, Alpine Speedwell and Highland Saxifrage that grow in the gully beneath the ice.
When we climb Tower Ridge or Observatory Ridge we will point out the Curved Woodrush that we go right past on the crests of these ridges. And if we ever get the chance to climb The Great Chimney, not only will we tell them of the importance of its first ascent by Jimmy Marshall and Robin Smith in 1960, but we will make sure to point out that it is home to a viable colony of Tufted and Alpine Saxifrages, the latter being recorded for the first time on Ben Nevis on the North Face Survey.

Mike Pescod
August 2016

PLANT IDENTIFICATION CARDS

ALPINE OR POLAR FOXTAIL
(Alopecurus Borealis)

This distinctive grass has purplish or grey-green flowering heads in a tight cylindrical shape between 1.5 - 3 CM long. Leaf blades are flat and hairless. Beside streams and in flushes, on mud & rocks in the stream or on wet, mossy and grassy slopes; often associated with late-lying snow.
PLANT IDENTIFICATION CARDS

ALPINE CAT’S-TAIL
(Phleum Alpinum)

Erect or ascending shoots from a curved base, this grass possesses a distinctive flowerhead with a dense panicle (cluster) of individual spikelets 10-30mm long and 8.5-12mm wide. The panicle is broadly cylindrical and does not narrow at the base. Leaves are 2.5-5mm wide and are flat without hairs.

ALPINE SAXIFRAGE
(Saxifrage nivalis)

Basal rosette of leaves, not dissimilar to starry saxifrage but the pattern of teeth is very distinctive, and the leaf shape is more elliptical than oblong. The leaves are also reddish-purple underneath. Flowers all together in a tight cluster at the end of the stem, with the red sepals upright around the five white, unspotted petals.
ALPINE MOUSE-EAR
(Cerastium Alpinum)

Low, mat-forming perennial, gray-ish green, hair. Vegetative stems creeping, flowering stems more upright. Leaves densely matted with long, (>1MM) tapering, shaggy, white hairs; especially on underside. Lowest leaves oval or elliptical, upper more pointed. Bracts with white margins. Stems with 1-4 large white flowers (18-25mm) with petals usually deeply notched, nearly to base. Sepals half the length of petals.

SIMILAR SPECIES; Arctic Mouse-ear
Petals less deeply notched and usually more bent over. Sparsely hairy or with at least some glandular hairs. Most hairs short, straight and yellowish making the plant appear more green.

HARE’S-FOOT SEDGE
(Carex Lachenalii)

This rather inconspicuous sedge has stems to 20cm, bluntly three-sided with fine lines or grooves. The leaves are shorter than the stems, 1-2mm broad, flat, dark green. The flowerhead is 2-4cm, red-brown with 2-5 spikes close together. The uppermost at the apex of a triangle completed by the next two spikes below. Wet slopes and ledges, especially in areas of late snow-lie.

These ID cards are an example of those developed for the North Face Survey by Cathy Mayne, Scottish Natural Heritage.
North Face Survey  
Year 3 Report (2016 - 2017)

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Year 3 Report (2016 - 2017)

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Year 3 Report (2016 - 2017)

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