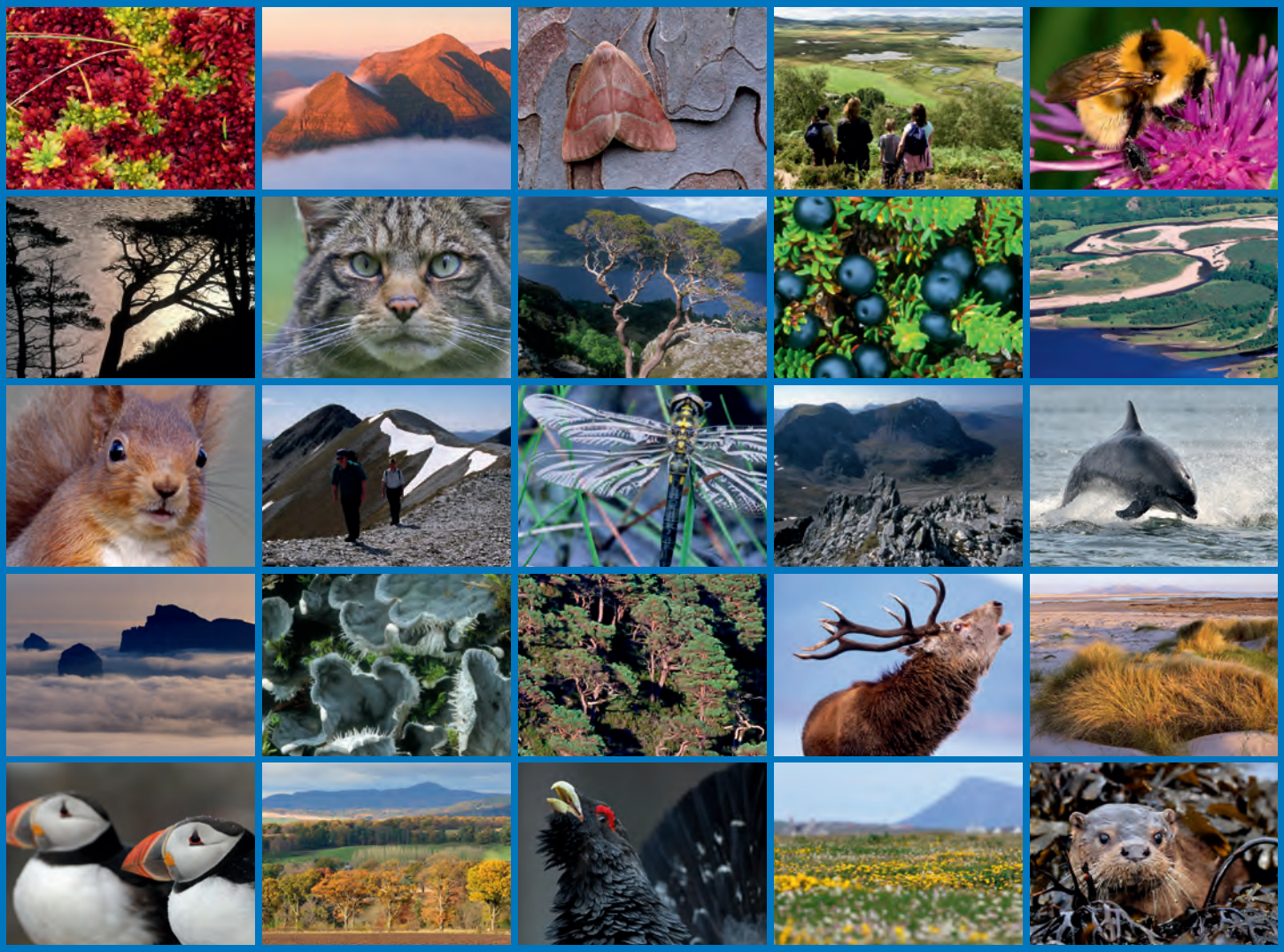
Scottish Natural Heritage
Commissioned Report No. 872

Site Condition Monitoring of invertebrate features at 19 designated sites in Scotland



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COMMISSIONED REPORT

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Site Condition Monitoring of invertebrate features at 19 designated sites in Scotland

For further information on this report please contact:

Athayde Tonhasca
Scottish Natural Heritage
Battleby
PERTH
PH1 3EW
Telephone: 01738 458671
E-mail: athayde.tonhasca@snh.gov.uk

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COMMISSIONED REPORT

Summary

Site condition monitoring of invertebrate features at 19 designated sites in Scotland

Commissioned Report No. 872
Project No: 13952
Contractor: Caledonian Conservation Ltd.
Year of publication: 2015

Keywords

Site condition monitoring; freshwater invertebrates; terrestrial invertebrates; invertebrate assemblage; sawflies; spiders; beetles; flies.

Background

This contract was set up to carry out site condition monitoring (SCM) of invertebrate assemblages at 19 Sites of Special Scientific Interest (SSSI) in Scotland, including the following outputs:

- To monitor the features specified.
- To produce datasets and reports for each site.
- To provide recommendations for future management of these features.

Main findings

We found the target notified features at four SSSIs (Flanders Moss, Glenmore Forest, Lismore Lochs and Loch Lubnaig Marshes) and a subset of species within target notified features at 10 SSSIs (Abernethy Forest, Alvie, Ben Lomond, Black Wood of Rannoch, Caingorms, Crathie Wood, Eastern Cairngorms, North Rothiemurchus Pinewood, River Spey – Insh Marshes and Whitlaw Mosses). We failed to find notified features at four sites (Ben Heasgarnich, Cadder Wilderness, Dollar Glen and Earlshall Muir). The sawfly species for which the Torridon Forest was notified is a misidentification so this feature is no longer valid.

For further information on this project contact:
Athayde Tonhasca, Scottish Natural Heritage, Battleby, Perth, PH1 3EW.
Tel: 01738 458671or athayde.tonhasca@snh.gov.uk
For further information on the SNH Research & Technical Support Programme contact:
Knowledge & Information Unit, Scottish Natural Heritage, Great Glen House, Inverness, IV3 8NW.
Tel: 01463 725000 or research@snh.gov.uk

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We would also like to thank Pete Moore (RSPB) for allowing us to borrow a Robinson moth trap during survey work for *Protolampra sobrina* at River Spey – Insh Marshes SSSI and Eamonn Flood (Caledonian Conservation Ltd) for kindly providing support as an experienced mountaineer during surveys at Eastern Cairngorms SSSI.

1. INTRODUCTION

This report describes the site condition monitoring (SCM) undertaken in 2013 and 2014 for selected invertebrate features at 19 Sites of Special Scientific Interest (SSSIs). Table 1.1 provides a summary of sites and features specified for survey as part of this project, and Figure 1.1 shows the geographic locations of the sites assessed in this report. The features surveyed and their details were specified by SNH. It should also be noted that although some SSSIs include several notified invertebrate features on their citation, only those specified for survey by SNH have been considered in this report (i.e. those listed in Table 1.1).

Table 1.1. Sites and features included in this project

Site	Feature	Details
Abernethy Forest	Invertebrate Assemblage	Araneae, Coleoptera (*Ampedus tristis*), Hemiptera (*Eremocoris fenestratus*), Hymenoptera (*Formica exsecta*, *Osmia uncinata*), Lepidoptera (*Protoampra sobrina*), Odonata (*Coenagrion hastulatum*)
Alvie	Invertebrate Assemblage	Diptera (*Hammerschmidtia ferruginea*), Coleoptera (*Donacia aquatica*), Mollusca (*Vertigo lilljeborgi),* Trichoptera (*Hagenella clathrata*)
Ben Heasgarnich	Sawflies	*Pachynematus arcticus*
Ben Lomond	Invertebrate Assemblage	Mountain ringlet (*Erebia epiphron*), Pearl-bordered fritillary (*Boloria euphrosyne*)[1], sawfly *Nematus reticulatus*
Black Wood of Rannoch	Invertebrate Assemblage	Several RDB spp. - Araneae, Coleoptera, Hemiptera, Hymenoptera, Lepidoptera, Odonata[2]
Cadder Wilderness	Invertebrate Assemblage	Beetle (*Cryptophagus corticinus*) and sawflies (*Arge enodis* and *Pseudohemitaxonus sharpi*)
Cairngorms	Invertebrate Assemblage	Several RDB spp. - Araneae, Coleoptera, Hemiptera, Hymenoptera, Lepidoptera, Mollusca, Odonata
Crathie Wood	Invertebrate Assemblage	Hemiptera (*Zygimus nigriceps*), moth (*Exaeretia ciniflonella*), northern brown argus (*Aricia artaxerxes*), mountain whorl snail (*Vertigo alpestris*)
Dollar Glen	Beetle (*Stenus glacialis*)	

Site	Feature	Details
Earlshall Muir	Beetle Assemblage	*Arena tabida* and *Pissodes validirostris*
Eastern Cairngorms	Invertebrate Assemblage	Coleoptera (*Bolitophagus reticulatus*), Hymenoptera (*Formica exsecta*), Lepidoptera (*Zygaena exulans*), Mollusca (*Vertigo geyeri*)
Flanders Moss	Spider (*Heliophanus dampfi*)	
Glenmore Forest	Narrow-headed ant (*Formica exsecta*)	
Lismore Lochs	Invertebrate Assemblage	Coleoptera (*Donacia aquatica*), Lepidoptera (*Eurodryas aurinia*)
Loch Lubnaig Marshes	Fly Assemblage	*Tetanocera freyi* and *Cordilura atrata* among others
North Rothiemurchus Pinewood	Invertebrate Assemblage	Araneae (*Clubiona subsultans*), Coleoptera (*Dryops nitidulus*, *Hydrochus brevis*), Hymenoptera (*Formica exsecta*, *Osmia uncinata*), Odonata (*Coenagrion hastulatum*)
River Spey – Insh Marshes	Invertebrate Assemblage	Coleoptera (*Donacia aquatica*), Lepidoptera (*Protoampra sobrina*)
Torridon Forest	Sawflies	*Pachynematus torridonensis*
Whitlaw Mosses	Sawflies	*Nematus monticola*, *Phyllocolpa acutiserra*, *P. carinifrons*[3]

[1]The summary document provided by SNH used the incorrect common name 'small pearl-bordered fritillary' for *Boloria euphrosyne*. This species is correctly referred to as 'pearl-bordered fritillary'.
[2]Although Odonata are specified in the Invertebrate Assemblage feature, SNH specified that surveys should not include this group as part of this project.
[3]Note that *Pyllocolpa carinifrons* is the valid name for the species previously misidentified as *P. excavata* (Liston & Sheppard, 2010).

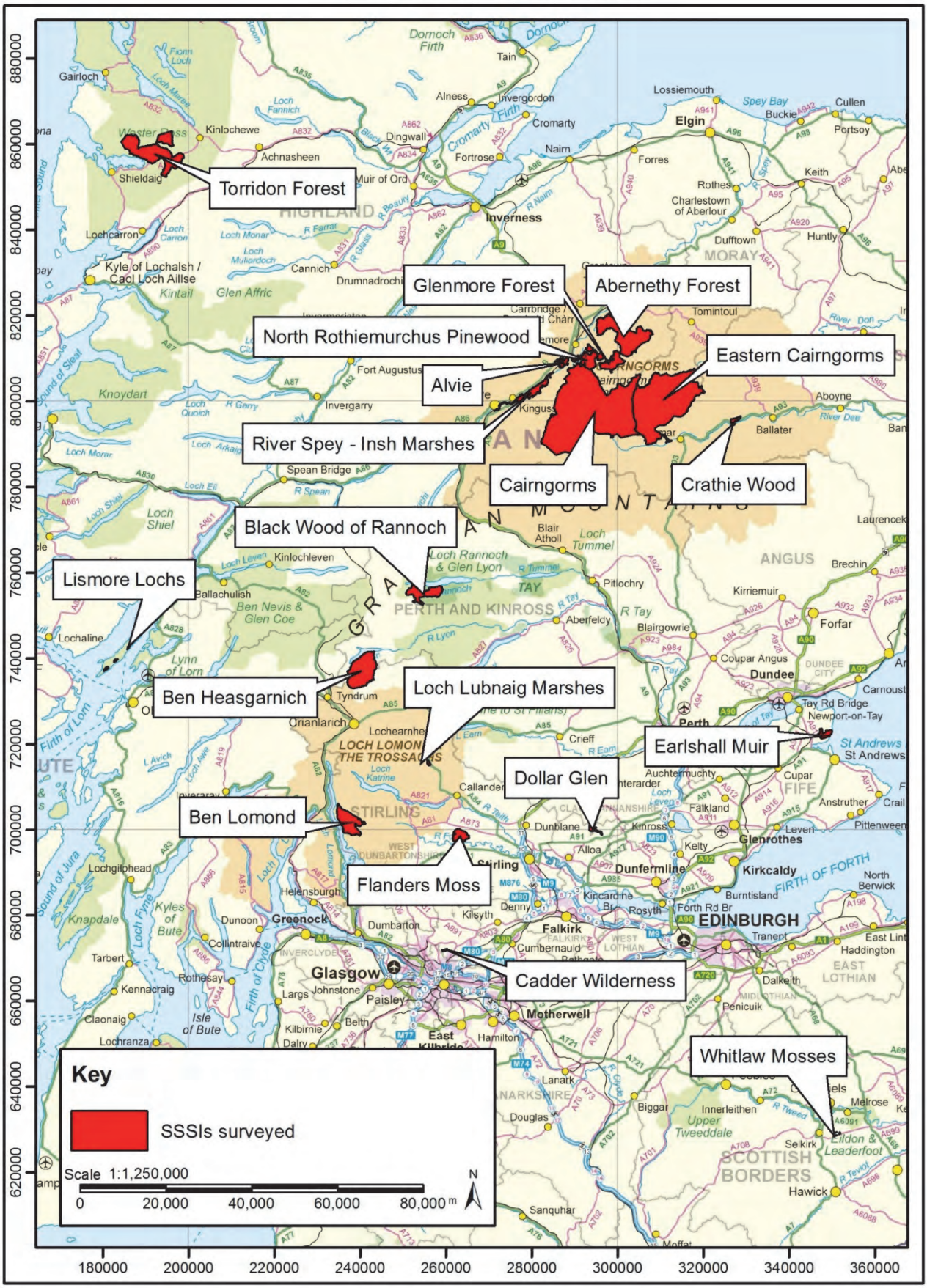

Figure 1.1. Geographic locations of Sites of Special Scientific Interest assessed.

Caledonian Conservation Ltd assembled a team of surveyors experienced in carrying out fieldwork in challenging conditions and also had many contacts of people in their respective fields, who provided essential information and advice during the project (Table 1.2).

Table 1.2. Survey team

Surveyor	Groups
Chris Cathrine	Araneae, Coleoptera, Hemiptera, Hymenoptera, Lepidoptera, Trichoptera
Adam Garside	Coleoptera
Chris Gleed-Owen	Mollusca.
Glenn Norris	Araneae, Coleoptera, Hemiptera, Hymenoptera, Lepidoptera, Trichoptera.
Scott Shanks	Coleoptera, Hemiptera, Lepidoptera.
Geoff Wilkinson	Diptera, Hymenoptera.
Jonathan Willet	Odonata.
Hayley Wiswell	Hemiptera, Hymenoptera, Lepidoptera.

Names of the species mentioned in the text followed sources detailed in Table 1.3.

Table 1.3. Sources of species names used in text

Taxa	Source
Araneae	• British Spider Recording Scheme website. Available at: http://srs.britishspiders.org.uk/
Coleoptera	• Duff (2008).
Collembola	• Hopkin (2007).
Diptera	• Chandler (1998).
Hymenoptera	• Skinner & Allen (1996). • Liston & Sheppard (2010).
Isopoda	• Gregory (2009).
Lepidoptera	• Waring & Townsend (2009), Fox & Asher (2010), Sterling & Parsons (2012).
Mollusca	• Anderson (2008), Welter-Schultes (2012), Rowson *et al*. (2014).
Odonata	• Davies & Tobin (1984, 1985).
Opiliones	• British Harvestmen Recording Scheme website. Available at: http://srs.britishspiders.org.uk/
Pseudoscorpiones	• British Pseudoscorpion Recording Scheme website. Available at: http://www.chelifer.com/pseudos/pseudoscorpions.htm
Vascular plants	• Stace (2010).
Bryophytes	• Atherton *et al.* (2010).

Table 1.4 defines the rarity designations used in describing the conservation status of species recorded. Rarity designations do not indicate the reason for the inclusion of any species as an invertebrate feature – they are included here for context only.

Table 1.4. Invertebrate conservation status/rarity designations

Abbreviation	Designation	Definition
Annex II	Annex II	Species listed under Annex II of the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, more commonly referred to as the EC Habitats Directive.
Schedule 5	Schedule 5	Species listed under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended).
RDB1	Red Data Book 1	Endangered: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are taxa which are known from a single location or only one 10 km square, taxa which occur in habitats known to be especially vulnerable, and taxa which have shown a continuous decline over the last 20 years and now exist in five or fewer 10 km squares (Shirt, 1987; Bratton, 1991).
RDB2	Red Data Book 2	Vulnerable: Taxa believed likely to move into the Endangered (RDB1) category in the near future. This includes taxa of which most or all populations are declining as a result of over-exploitation, extensive destruction of habitat or other environmental factors; taxa with populations that have been seriously depleted and whose ultimate security is not yet assured; and taxa with populations that may still be abundant but are under threat from serious adverse factors throughout their range (Shirt, 1987; Bratton, 1991).
RDB3	Red Data Book 3	Rare: Taxa with small populations that are not at present Endangered (RDB1) or Vulnerable (RDB2), but are at risk. In the UK this is considered to be species which exist in 15 or fewer 10 km squares (Shirt, 1987; Bratton, 1991).
RDBK	Red Data Book K	Insufficiently Known: Taxa suspected to fall within categories RDB1, RDB2 or RDB3 but which are data deficient and so cannot be assigned to other Red Data Book categories with confidence (Shirt, 1987; Bratton, 1991).
NS	Nationally Scarce	Recorded in 16-100 10 km squares since January 1 1980. Nationally scarce replaces the Nationally Notable A (Na) (recorded in 16-30 10 km squares since 1 January 1980) and Nationally Notable B (Nb) (recorded in 31-100 10 km squares since 1 January 1980) designations. Recorded in 16-30 10 km squares since 1 Jan 1980.

2. METHODS

As the study involved the survey of a wide range of invertebrate taxa, we employed a variety of sampling techniques. Details of our site specific survey designs are provided in the individual site accounts. Sample locations were recorded with handheld GPS units and then digitised with ArcGIS 10 for the production of accurate maps.

2.1 Desk study

We undertook a desk study to identify historic records, previous SCM reports and to identify suitable survey locations within sites (which was particularly important for larger sites). In some cases Site Citations do not indicate which species are included in the 'invertebrate assemblage' feature and every effort was made to determine target taxa based on existing site information. In some cases, however, we were unable to identify target taxa responsible for the 'invertebrate assemblage' notification, and so surveys were designed to encompass a wide range of invertebrate groups.

Prior to fieldwork, we identified existing records wherever possible using a variety of sources, including the National Biodiversity Network (NBN), additional datasets managed by national Recording Schemes and Societies and professional contacts. In some cases it was necessary to go through paper files held by SNH area offices to try to find the origins of some records, and to determine if SCM had been carried out previously (in many cases reports of previous SCM work were unavailable, and may not have been completed).

Unless otherwise specified, 'historic' records refer to those collated from the full range of available sources indicated above.

2.2 Freshwater invertebrates: Odonata

Surveying for upland species of adult insects is unpredictable due to rapidly changing conditions and very local weather systems. The techniques used during this study have been developed in the field over a period of years and have most recently been used during the 2011 to 2012 Odonata SCM undertaken for SNH.

We completed surveys during the best weather conditions in late-May and August 2013 and 2014. The two survey periods ensured that adults of both early (large red damselfly) and late (black darter) species were on the wing. Details of methodology are described below.

2.2.1 Early visit – larval survey

Although weather is not a key consideration for larval sampling, it is best to undertake this when it is not too cold, windy or wet. Larval sampling was, therefore, completed when the temperature was 15 °C or above, wind speed was at or below Beaufort Force 4 and there had not been significant rainfall for three days.

Most larvae would have started to emerge by mid-May or June, and so the ones caught when sampling would be in the final larval stages and were more straightforward to identify with confidence due to their large size.

Larval sampling was undertaken by 'guddling'. This involves using a colander as a net and sweeping it through emergent vegetation, along the pool edge or along the pool's bottom. Guddling is the standard Scottish larval sampling technique and is most useful when dealing with pools with lots of sphagnum that tend to choke normal pond nets.

When approaching a pool, we followed a hierarchy of actions:

1. Observe for any adult activity.
2. Observe the edges of the pool and any marginal vegetation for signs of emerging adults or exuviae (the cast larval skin left behind after the emergence of the adult).
3. Identify any exuviae and emergent adults.
4. Mark the site of any emergent adults to avoid damaging them during the survey.
5. Start larval sampling, until a larva is found or a maximum of 20 dips.
6. Record all Odonata species as adult or larva, seen or captured and any other readily identifiable species.

This process was then repeated for all pools if there were not too many to sample in a day. Otherwise a representative sample was taken from each area.

2.2.2 Late visit – adult survey

This second visit focused on recording adults, although formal adult transect surveys were not used. Hence this survey was completed during the best weather conditions in late June, July or August. Late July is the peak flight period for most Odonata species, with the exception of those that emerge early in the summer. High wind speed and significant cloud cover are the two key factors inhibiting adults flying if the temperature is over 15 °C. Wherever possible, we completed surveys on days with a temperature over 17 °C, very little wind and under 50% cloud cover. In some cases, however, surveys were completed during sub-optimal conditions.

We revisited the pools that were surveyed for larvae during the early visit. Suitable vantage points were identified, allowing a view over potential basking/perching sites and breeding pools. Ten min watches with 5 min breaks were completed at various sites between 10:00 and 16:00 h although, if the weather was optimal, watches continued later into the evening.

2.3 Freshwater invertebrates: Trichoptera

We collected adult Trichoptera specimens by sweep-netting vegetation where the adults often rest. A light trap was also employed (see Terrestrial invertebrates: Lepidoptera methods below).

2.4 Mollusca

For the three whorl snail (*Vertigo* spp.) interests at Crathie Wood, Eastern Cairngorms and Alvie respectively, we employed a standard 1L substrate sampling tailored to their minute size, at locations fitting the ecology of each species. For Cairngorms, we used the same methodology, with no target species, but on locations likely to support *Vertigo* spp. In addition, we recorded incidental visual encounters of molluscs during the course of fieldwork. The methodologies are described below.

We carried out the fieldwork between 29 June and 7 July 2013. We collected substrate samples to fill a 1 L plastic tub, without compressing the material significantly. We selected the sampling locations according to the target species ecology, and used a handheld GPS to record the coordinates. We collected 66 samples (Alvie 10, Cairngorms 20, Crathie Wood 10, Eastern Cairngorms 26). Depending on the habitat setting, the samples were composed of plants and litter of variable characteristics with varying proportions of minerals, humus and organic or mineral mud.

For all three target species, we identified suitable locations by selecting appropriate habitat types, and referring to previous surveys. For *V. lilljeborgi* we sampled wetland-edge litter; for *V. geyeri* we sampled wet flushes and for *V. alpestris* we sampled mossy scree litter.

Note that our approach differed somewhat from that of Killeen & Colville (1999) methodology for detecting *V. geyeri* in Eastern Cairngorms. They only collected short sedge plants whereas we bulked sedges, herbs, bryophytes and a scraping of substrate together. This bulk-sampling approach is used successfully by other workers in the UK (M. Willing, pers. comm.), but equally our sample size was modest compared to the 12 L used by some European workers (Schenková *et al.,* 2012).

We processed the samples in July 2013 by wet-sieving each one with a water hose through two metal sieves (4 and 0.5 mm) over a solid metal base. We placed the paired residues in plastic trays and air-dried them in a greenhouse for a week. We then bagged and labelled each pair of residues for later examination. Before examination we dry-sieved the >4 mm residue through a 2 mm mesh metal sieve to separate finer material. Thus each sample comprised three fractions.

We examined the >4 mm residue by eye, and used fine tweezers to remove any mollusc shells. We examined the 0.5 to 4 mm residue and 2 to 4 mm residue under low-power binocular reflected-light microscope at magnifications of x5 to x30. We placed small amounts of residue on a plastic petri-dish at a time, and used fine tweezers and fine paint brush to remove all mollusc shells.

We counted and identified the resulting snail shells and bivalves to the highest taxonomic level possible, assisted by identification guides, keys and atlases (Kerney & Cameron, 1979; Kerney, 1999; Killeen *et al.,* 2004; Cameron, 2008). We divided shells/valves into adult (full size) and juvenile (less than normal full size) categories, and tabulated the counts for each sample.

During the course of fieldwork, which involved walks of 10-20 km per day, we recorded all visual encounters of non-target molluscs that could be readily identified without adding delay. This favoured the recording of large conspicuous species, and disadvantaged the recording of inconspicuous species and small slugs that require close examination for identification. As the fieldwork for Crathie Wood, Eastern Cairngorms and Loch Alvie targeted small whorl snail species, this casual recording did not form part of the formal sampling efforts, although it gathered useful additional mollusc data. The identification of slugs was assisted by a new key from Rowson *et al.* (2014). Visual recording accounted for around 40 additional mollusc records.

2.5 Terrestrial invertebrates: Araneae, Coleoptera, Hemiptera and Hymenoptera (excluding *Formica exsecta*)

Specimens collected were identified on site or preserved in a 70% isopropanol and 30% water mixture.

Hand searches
Appropriate microhabitats for targeted notified features were searched by hand. This involved 'grubbing' in the ground layer, overturning stones, and a range of equipment such as 'pooters 'and tuning forks (to lure spiders out onto their webs), amongst other specific techniques as appropriate (such as searching fungal fruiting bodies for particular species of beetles).

Pitfall traps
Transects or grids or randomly located pitfall traps were used as appropriate. Each pitfall trap consisted of a plastic cup dug into the ground so that the lip is flush with the substrate surface. Chicken-wire was used to cover traps to prevent small vertebrates from becoming trapped, and was attached so as to ensure that it could not be dislodged if kicked or if the trap was dug up (e.g. by a badger or dog). A mixture of 70% antifreeze and 30% water was

added to a depth of 2.5 cm in each trap, and a drop of washing-up liquid was used to break surface tension (Figure 2.1 – except for maps, all figures are in the Appendix). Propylene glycol antifreeze was used as it is less attractive and harmful to vertebrates than the sweet-smelling ethylene glycol antifreeze. Traps were left *in situ* for two weeks, at which point the catches were collected. Traps were then removed or reset.

Bark traps
We used bark traps to sample invertebrate species that live under tree bark and are normally difficult to collect. A trap consisted of two layers of plastic bubble wrap (40 x 40 cm), with bubbles facing each other so as to provide artificial habitat. Dark plastic was used to cover the traps outside to prevent light from penetrating, and the traps were wrapped around a tree with wire at 1.5 m height. Bark traps constructed from bubble wrap have been shown to be more effective than those with a corrugated cardboard base, another popular design (Isaia *et al.,* 2006). Traps were then left *in situ* for a minimum of four weeks, allowing invertebrates to colonise this new habitat (Figure 2.2). Afterwards invertebrates living between the traps and tree bark were collected first, and then the traps were opened and animals living between the bubble wrap layers were collected and the traps removed.

Spider nest boxes
Nest boxes were placed on trees in suitable woodland habitat to target *Clubiona subsultans*, as this species was recorded to use them during surveys for *Osmia uncinata* (Sears *et al.*, 2014). Nest boxes consisted of bundles of short lengths of bamboo canes held together by plastic tubing, and were attached to trees with wire at a height of 1.5 m (Figure 2.3). Nest boxes were left *in situ* for a minimum of four weeks, then collected and returned to the lab in sealed plastic bags.

Sweep net transects
Transects were walked for 30 minutes while sweeping through vegetation with a robust net, sampling a variety of micro-habitats.

Aerial net transects
Transects were walked while sweeping through vegetation with an aerial net for 30 minutes, targeting areas supporting food plants appropriate to target species. Surveys were completed in good weather conditions, with temperatures of 15 °C or higher, low wind (less than Beaufort Force 3) and no cloud cover.

Deadwood sampling
We collected specimens from under the bark and layers of deadwood with a screwdriver to gain access.

Beating and bark brush sampling
A large, soft paint brush was used to dislodge invertebrates (particularly spiders and beetles) from bark into a tray held underneath (Figure 2.4). Trees were then gently beaten so as to dislodge further invertebrates into a white sheet at the base of the tree. Beating was also used in isolation on some occasions to dislodge invertebrates from young trees or bushes.

Bugvac
A modified leaf blower (Husqvarna 125BVX) was used to suction invertebrates from ground level. This has proven the most effective method of establishing the presence of species that live in less accessible micro-habitats such as the base of vegetation, or for small invertebrates which are often under-recorded by more traditional sampling techniques (Wilson *et al.*, 1993). For example, this method was very effective for detecting *Heliophanus dampfi,* which prefers the bases of *Molinia* and *Eriophorum* tussocks in lowland raised bog habitats (Cathrine, 2012). Each sample involved pressing the bugvac nozzle to the ground for 10 seconds at five points (Figure 2.5). Specimens were then emptied from the net into a

white plastic tray and collected with forceps. All specimens were stored in tubes with labels giving details of the date, habitat and locality of the captures

2.6 Terrestrial invertebrates: Diptera

The most frequent method of recording Diptera is to collect and identify adults. Some species are, however, easier to detect in their larval or pupal stages. We therefore sampled both adult and immature stages as appropriate to the target species.

We sampled adult Diptera by sweep netting. This involved drawing a 40 x 60 cm muslin net quickly through the vegetation to dislodge and catch insects. At the end of each sweep, insects were removed from the net by 'pooter' or tube.

The puparium is often the most convenient stage to survey as it frequently remains in the breeding site for up to two years after adult emergence. Sampling puparia involved breaking apart some of the breeding media (e.g. decaying wood) and extracting the puparia with forceps.

2.7 Terrestrial invertebrates: *Formica exsecta*

After defining a survey area, we undertook a thorough walk through of suitable habitat by following fixed transects at 5 m to 10 m intervals, depending on the height of vegetation. Ants from any nest mound were identified to species with a x20 hand lens. Other species of ant encountered along the transect were also identified and recorded. *Myrmica* species were collected in ethyl acetate and taken back to the lab to be identified with a microscope. Nest locations were recorded with a hand-held GPS. The survey was carried out on dry, sunny days when the ants would be active. Presence of *F. lemani* was also noted in each area surveyed as this species is believed to be a host for *F. exsecta* and is considered to be important in the formation of new nests (Hughes, 2006).

2.8 Terrestrial invertebrates: Lepidoptera

Visual surveys for day-flying adults
Surveys for butterflies and day-flying moths were completed during optimal conditions recommended for butterfly transects, i.e. between 10:45 and 15:45 h, in dry conditions, wind speed less than Beaufort Force 5, and temperature 13 °C or higher if there is at least 60% sunshine, or more than 17 °C if overcast (Pollard & Yates, 1993). Depending on the target species, transects were focused on specific habitats. For most butterflies and day-flying moths, this equated to south facing, sheltered areas containing nectaring plants and suitable larval food plants. A zigzag route was walked with a butterfly net, and a pair of close-focusing binoculars was used to identify flying specimens.

Visual surveys for larvae
Surveys for Lepidoptera larvae were focused on areas of suitable breeding habitat likely to contain the food plant. If patches of breeding habitat were relatively small, the entire area was searched for suitable food plants and larvae or indications of larval feeding damage on parallel transect lines. Larger areas were surveyed by zigzag routes across at least 2% of the area, recording larvae or possible larval feeding damage within 2 m of the transect route. This method is used to calculate the density of Marsh fritillary *(Eurodryas aurinia*) larval webs (UK Butterfly Monitoring Scheme, undated). Photographs of larvae or feeding damage were taken.

Light-trapping moths
Two types of traps were used: a 'Robinson' trap with a mercury vapour (MV) lamp and powered by a generator (Figure 2.6), and a 12 volt battery-powered 'Heath' trap, with a low wattage actinic bulb (Figure 2.7). Robinson traps are more powerful but less mobile,

whereas Heath traps are more easily deployed in remote locations. Both types are standard moth-trapping equipment (Randle, 2011). In both traps, moths come to rest inside a collection chamber where they can be examined soon after capture, or left until daytime. The traps were operated from dusk until dawn, or for a shorter period if there was a risk of rain (hot bulbs may shatter).

Wine-ropes and 'sugaring'

Nocturnal moths will also come to artificial nectar known as 'sugar', a mixture of brown ale, brown sugar and black treacle. Just before dusk, the mixture is spread on tree trunks or fence posts at about eye level. 'Sugar' normally works best for around the first 2 hours of darkness (Randle, 2011).

2.9 Terrestrial invertebrates: Symphyta

The most frequently used method of recording sawflies is to collect adults. However, it is possible to identify some species by their larval feeding activities such as leaf curls and galls. We sampled adult sawflies by sweep netting. This involved drawing a 40 x 60 cm muslin net quickly through the vegetation to dislodge and catch insects. At the end of each sweep, insects were removed from the net by pooter or tube. Samples of galls and leaf curls were collected and, when possible, either identified to species after rearing them to adults.

2.10 Lab identification

Wherever possible, specimens were identified in the field. If not, specimens were preserved in isopropanol for later identification in the lab with stereo- or compound-microscopes as appropriate. For molluscs, the isolation and identification of target species was only possible after processing of the 1 L samples. Voucher specimens were retained where appropriate. Where necessary, we compared specimens with museum collections to confirm identification. We focused identification effort on the target taxa for notified features. However, other non-target specimens were identified to species level as time allowed, providing a more comprehensive species list for the sites. Appropriate references were used in the identification of specimens (Table 2.1).

2.11 Habitat assessment and site condition evaluation

An evaluation of habitat condition in relation to invertebrate features was made at each site, taking into consideration factors that may affect the suitability of habitats. Recommendations are also provided based on this assessment

Table 2.1. References used for identification of specimens

Taxa	Identification References
Araneae (spiders)	• Locket & Millidge (1951, 1953), Roberts (1993, 1996), Almquist (2005, 2006).
Coleoptera (beetles)	• Joy (1932), Halstead (1963), Johnson (1966), Brendell (1975), Unwin (1984), Morris (1990, 1997, 2002, 2008, 2012), Kirk-Spriggs (1996), Laibner (2000), Fitton & Eversham (2006), Luff (2007), Lott (2009), Foster & Friday (2011), Lott & Anderson (2011), Duff (2012).
Collembola (springtails)	• Hopkin (2007).
Diptera (true flies)	• Ball (unpublished), Rozkosny (1984), Ball & Morris (2013).
Ephemeroptera (mayflies)	• Macadam & Bennett (2010).
Hemiptera (true bugs)	• Southwood & Leston (1959), Unwin (2001), Biedermann & Niedringhau (2009), Kunz *et al*., (2011), Stöckmann *et al.* (2013).
Hymenoptera (bees, wasps, ants and sawflies)	• Benson (1952, 1958), Skinner & Allen (1996), Edwards & Jenner (2009), Wright (1990).
Ispoda (woodlice and waterlice)	• Hopkin (1991), Oliver & Meechan (1993).
Lepidoptera (butterflies and moths)	• Waring & Townsend (2009), Thomas & Lewington (2010), Sterling & Parsons (2012).
Mollusca (snails and slugs)	• Macan (1949), Kerney & Cameron (1979), Kerney (1999), Killeen *et al.* (2004), Cameron (2008), Welter-Schultes (2012), Rowson *et al*., (2014).
Myriapoda (centipedes and millipedes)	• Lee (2007), Barber (2008, 2009).
Odonata (dragonflies and damselflies)	• Brooks (2010).
Opiliones (harvestmen)	• Hillyard (2005).
Pseudoscorpiones (pseudo scorpions)	• Legg & Jones (1988), Legg (2001).
Trichoptera (caddisflies)	• Wallace (2006), Barnard & Ross (2012).

3. SITE REPORTS

The following sections provide detailed site reports for each SSSI. A description of the site and the invertebrate feature considered were included, but in some cases the feature details were vague, and attempts were made to better define these with available information. However, there are inconsistencies between the approach used to define features between sites, and in some cases the species for which an assemblage was notified are ambiguous or even unknown.

3.1 Abernethy Forest

3.1.1 Site description

Abernethy Forest SSSI covers 5,793 ha between 200 m and 600 m in elevation. The site supports one of the largest areas of native pinewood in Britain, which once formed part of a continuous tract of woodland around the lower slopes of the Cairngorms. It is part of the eastern group of pinewood types that includes Glen Tanar, Rothiemurchus and Ballochbuie. Many species of plants and animals found only in native pinewoods occur here and, as such, the site is of national importance.

Parts of the site consist of almost completely undisturbed high forest but much of the northern area is semi-natural, with some woodland being planted since the mid-eighteenth century. The forest retains a high degree of natural habitats and a good tree structure in the presence of a shrub layer of juniper (*Juniperus communis*) and areas of bog woodland. Some sections of woodland are partly or completely dominated by native broadleaf tree species – particularly birch (*Betula* spp.).

The site also supports other habitats, including montane and sub-montane, oligotrophic and mesotrophic valley and basin mires with systems of long aligned pools, raised bog, dry heather-bearberry, *Calluna-Arctostaphylos* heath, the River Nethy and a series of lochs and small lochans.

The site supports a wide variety of biological features, including fungi, lichen and vascular plant assemblages, native pinewood, basin fen, raised bog, subalpine dry heath, capercaillie (*Tetrao urogallus*), Scottish crossbill (*Loxia scotica*), crested tit (*Lophophanes cristatus*), osprey (*Pandion haliaetus*), breeding bird assemblage, beetle assemblage and dragonfly assemblages as well as the invertebrate assemblage considered as part of this study.

The site includes some publically accessible RSPB reserve attractions, so some areas are heavily used by the public.

3.1.2 Summary of known invertebrate interests

This study was aimed at the notified invertebrate assemblage feature. This feature is poorly defined in the citations and Site Management Statements, so additional documentation provided by SNH was used to help target surveys (Scottish Natural Heritage, 2003a).

3.1.2.1 *Araneae*

Six rare spider species have been recorded on site (Scottish Natural Heritage, 2003a):

Dipoena torva (wild gallows-spider) RDB2
Dipoena torva is restricted to Caledonian pine forests where it spins small webs in the fissures of Scots pine (*Pinus sylvestris*), and preys on wood ants. It is known from just six sites in Scotland, but is well distributed and frequent at these locations. Both sexes can be found in June, and females are also found until September.

Haplodrassus soerenseni (Soereson's grasper) RDB2
This species is found in the ground vegetation of Caledonian forest. This is a hunting spider on the ground layer and is apparently restricted to Caledonian pine forest, with a preference for open woodland. Adults can be found in June and July. It requires more open areas, and may prefer glades (Harvey *et al.,* 2002). Specimens have been found in June and July.

Pelecopsis elongata (Caledonian balloon-head) RDB2
This spider inhabits dry pine litter, rocks and the lower branches of juniper in Caledonian pine forest. It is thought to be most active during the winter, although females are also found throughout the summer between June and August.

Clubiona subsultans (Caledonian sac-spider) RDB2
Clubiona subsultans is associated with Scots pine where it is found under bark and in the pine litter. *Clubiona subsultans* is restricted to pine forests in the UK and is only found in the central Scottish Highlands. However, it is often not uncommon where present. During a recent study targeting *O. uncinata,* this species was often the most common spider found in nest boxes used in Abernethy (Sears *et al.*, 2014). Adults of both sexes have been found between March and September.

Notioscopus sarcinatus (swamp lookout spider) NS
This spider is found in wet woodlands amongst *Sphagnum* spp. and *Polytrichum* spp. Although widespread in Britain, records are scarce. Adults of both sexes have been found throughout much of the year.

Dismodicus elevatus (highest sphere-head) NS
Dismodicus elevatus is generally found in ancient Caledonian pine forests, although it can be found in conifer plantation also. It lives on heather (*Calluna vulgaris*, *Erica* spp.), gorse (*Ulex europaeus*) and juniper associated with pine, so may be more frequent than current records suggest. The only recent records, however, have been from Abernethy Forest. Males are found between May and July, and females between May and September.

3.1.2.2 *Coleoptera*

Ampedus tristis RDB1
This is a species confined to Caledonian pine forest in Britain, although there are a very few records in central Scotland. Associated with Scots pine, this saproxylic beetle lives its carnivorous larval stage in decaying logs and emerges as an adult after four to six years in early summer.

3.1.2.3 *Hemiptera*

Eremocoris fenestratus RDB1
This is a large ground bug associated with juniper and a litter layer. It was thought to be extinct until its recent discovery amongst cypress bushes in London.

3.1.2.4 *Hymenoptera*

Formica exsecta (narrow-headed ant) RDB1
This is a rare wood ant restricted to the Scottish Highlands and one remaining site in England. It is an important indicator of a healthy woodland ecosystem, as it is associated with natural and man-made open glades and edges. Records for *F. exsecta* were provided prior to the survey by Andy Amphlett, RSPB, the majority of them generated by a survey of the site in 2000 and 2001 by Gus Jones. A total of 491 records exist for the species dated from 1998 with the most recent records made in 2012. Nests are widespread across the SSSI, being found in woodland glades, bog woodland, telegraph and power line way leaves and heathland habitat. There is no programme currently in place to monitor this species on

the site, although nest locations are noted prior to management such as muir burning (Andy Amphlett, pers. comm.).

Osmia uncinata (pine mason bee) RDB2
Osmia uncinata lives in open areas of Caledonian pine forest that offer plentiful sunlight and its food plant, common bird's-foot-trefoil (*Lotus corniculatus*). Nests of the bee are yet to be found due to its preference to fly only on warm sunny days and its potentially small population.

3.1.2.5 *Lepidoptera*

Protolampra sobrina (cousin German) RDB3
Protolampra sobrina is an RDB3 species. Its larvae feed on blaeberry (*Vaccinium myrtillus)* and heather in the early instars, and following hibernation move on to young leaves of birch and eared-willow (*Salix aurita)* scrub. Preferred habitat includes upland birch woodland and scrub at altitudes over 200 m above sea level where it can be attracted to light in late July and August. This moth is most commonly found where small birches are growing amongst blaeberry and heath vegetation. It is classed as nationally scarce and has always been considered a species of the Scottish Highlands, with records in the Spey valley, Dee valley, Loch Rannoch and Western Ross.

3.1.2.6 *Odonata*

The dragonfly assemblage includes rare species such as the northern damselfly (*Coenagrion hastulatum*) (a notified feature in its own right as well as detailed in the invertebrate assemblage feature), white-faced darter (*Leucorrhinia dubia*) and the northern emerald (*Somatochlora arctica*), which breed in the forest mires and lochans. The 2002 SCM determined this feature to be in favourable-maintained condition.

Coenagrion hastulatum (northern damselfly) RDB2
This species favours fairly shallow water bodies with a consistent water level and abundant emergent vegetation. Smith & Smith (1996) listed 26 breeding sites, and there are now known to be over 60 breeding sites at Strathspey, Deeside and Perthshire (Pat Batty, pers. comm.). Recently single sites near Nairn, in Moray and at Castle Fraser Aberdeenshire have been discovered, suggesting the species is under-recorded. This species is classified as Endangered (EN) due to an observed decline (Daguet *et al*., 2008). This does, however, seem to reconcile with the new sites being discovered. Regardless, this species is still the rarest breeding odonatan in Scotland (except for the species expanding their range into southern Scotland). The lack of records and consistent recording prevents detecting statistically robust population trends.

Somatochlora arctica (northern emerald dragonfly) RDB3
This is the most common of the three emerald dragonflies found in Scotland. This species is widespread in the Central and West Highlands and is not found in Deeside. It prefers sphagnum-fringed or choked pools with some open water. Suitable breeding habitat can appear too dry when visited in the summer. The current status of this species is uncertain; it was classified as Vulnerable in 1987 although this has been changed to Near Threatened (NT) in the 2008 Odonata Red Data List. Daguet *et al*. (2008) stated; "it should be closely monitored throughout its range, and that particular attention should be paid to the effects of climate change and global warming on its distribution". It is a rare species occurring in just over 50 hectads (10 km squares) but is certainly under-recorded.

Leucorrhinia dubia (white-faced darter) NS
This is a bog specialist, mainly preferring deeper pools; it can be found in shallower pools in high population densities. It is the only darter on the wing from early June. The male's red

and black colouration is unmistakable, plus only both sexes of this species have a white 'nose'. It is found from Western Ross through Speyside to a few sites in Deeside and Perthshire. Its patchy distribution is probably due to under-recording. This species is classified as Vulnerable (VU) on the 2008 Odonata Red Data List (Daguet *et al*., 2008) as it is becoming extinct in many sites in the south of its range in England. In Scotland the situation is different and several new sites have been found in the last five years.

Methods

3.1.2.7 *Terrestrial invertebrates (excluding* F. exsecta*)*

In order to collect the widest range of terrestrial invertebrates, several methods were employed over the summer. Each was adjusted to specific locations in accordance to individual life histories, previous records and access restrictions. Sample locations (Figure 3.1, Table 3.1) were selected over a range of specific habitats based on previous records and Andy Amphlett's habitat knowledge.

Ampedus tristis larvae require decaying wood at least six years old, so sweeping and pitfall trap transects were located in compartments of at least 30 year-old woodland. Samples were collected on 19, 20 and 21 June and pitfall trap transects were set on 4 and 5 June and collected on 19 and 20 June. Three pitfall transects of five traps were laid in areas of Caledonian pine forest, each with a different understory, consisting of sphagnum bog, dense juniper and ericoid shrub.

Previous records of *E. fenestratus* were targeted where the understory comprised mostly juniper. These locations were sampled with bugvac and pitfall traps on 31 July and 1 August.

Surveys of *O. uncinata* were carried out by aerial netting on sunny rides where previous records had been made. Transects were undertaken throughout June and July, but only if temperatures were above 15 °C and there was no cloud cover.

For surveying Araneae, pitfall traps, bugvac and sweeping were used. Bark traps and nest boxes were also used to collect *D. torva* and *C. subsultans,* as they inhabit the fissured tree bark of Scots pine and birch and are very difficult to find using other methods. In order to target *D. torva,* bark traps were placed on trees either in close proximity to nests of wood ants or with visible wood ant trails on the trunk. Twenty bark traps and eight nest boxes were left *in situ* for at least a month.

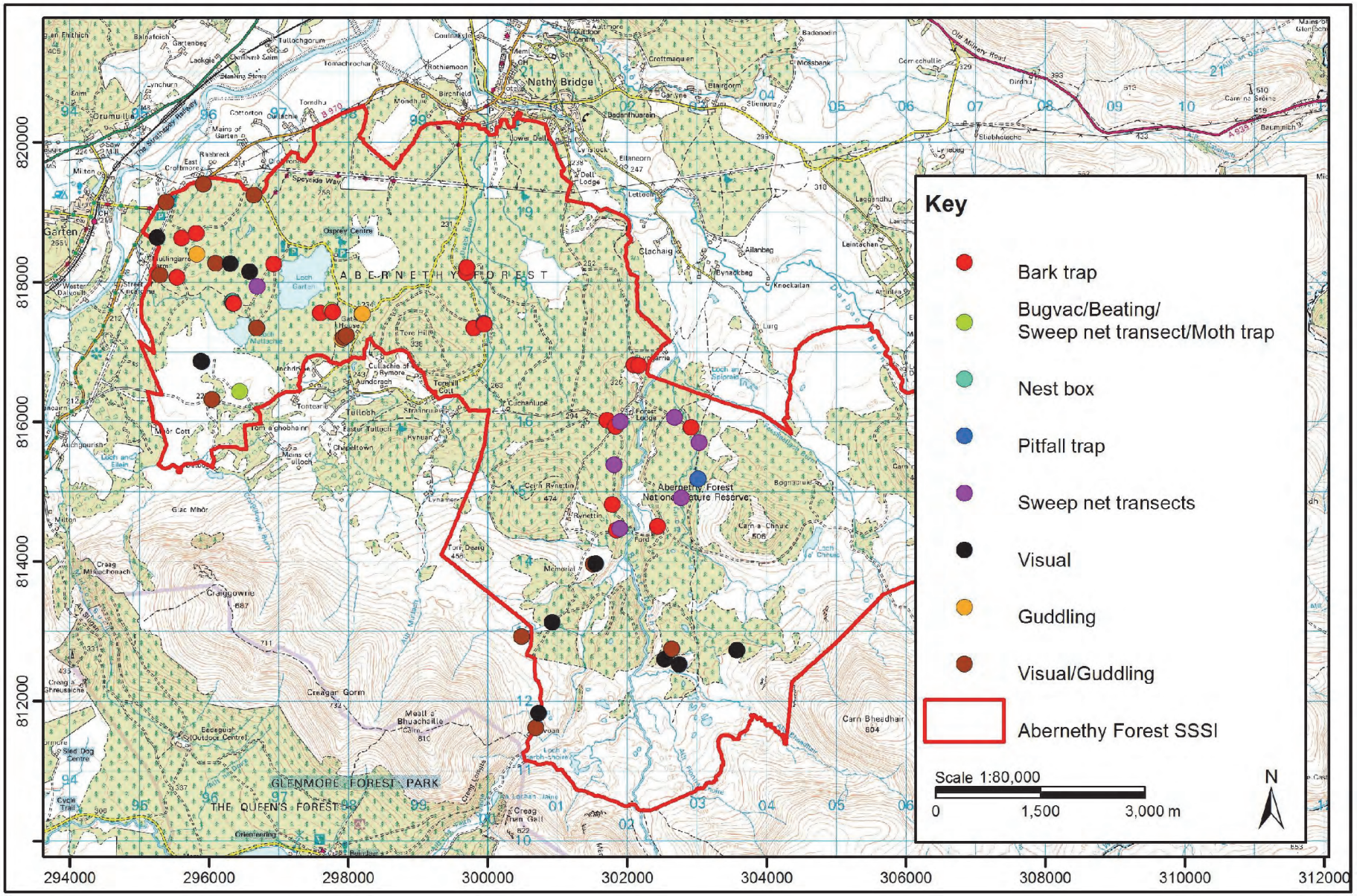

Figure 3.1. Survey locations in Abernethy Forest SSSI

Table 3.1. Sample locations at Abernethy Forest

Grid reference	Sampling method	Location description
NH9693018259	Bark trap	Caledonian pine forest with sphagnum ground flora
NH9635417695	Bark trap	Caledonian pine forest with sphagnum ground flora
NH9554418068	Bark trap	Caledonian pine forest with sphagnum ground flora
NH9561218633	Bark trap	Caledonian pine forest with sphagnum ground flora
NH9582018702	Bark trap	Caledonian pine forest with sphagnum ground flora
NH9777817578	Bark trap	Caledonian pine forest
NH9760017559	Bark trap	Caledonian pine forest
NH9969118135	Bark trap	Willow (*Salix* spp.) stand within marsh
NH9970118210	Bark trap	Caledonian pine forest
NJ0209716814	Bark trap	Open Caledonian pine forest
NJ0216416812	Bark trap	Scots pine plantation
NH9994917400	Bark trap	Caledonian pine forest
NH9980617345	Bark trap	Caledonian pine forest on the banks of a stream
NJ0291615919	Bark trap	Caledonian pine forest
NJ0301815181	Bark trap	Caledonian pine forest
NJ0243614508	Bark trap	Caledonian pine forest
NJ0185014452	Bark trap	Caledonian pine forest
NJ0178814819	Bark trap	Caledonian pine forest
NJ0183215937	Bark trap	Caledonian pine forest
NJ0171116021	Bark trap	Caledonian pine forest
NH9634917699	Pitfall trap transects	Caledonian pine forest with sphagnum ground flora
NH9994617412	Pitfall trap transects	Caledonian pine forest on the banks of a stream
NJ0301815185	Pitfall trap transects	Caledonian pine forest
NH9644316439	8V Heath trap	Tulloch Moor
NH9776217594	8V Heath trap	Caledonian pine forest
NJ0291715248	Nest box	Caledonian pine forest
NJ0293215260	Nest box	Caledonian pine forest
NH0301815179	Nest box	Caledonian pine forest with sphagnum ground flora
NH0302515177	Nest box	Caledonian pine forest with sphagnum ground flora
NH9643416421	Sweep net transects/beating/bugvac	Tulloch Moor
NH9669117942	Sweep net transects	Caledonian pine forest
NH9803119519	Sweep net transects	Caledonian pine forest ride
NH9807819499	Sweep net transects	Caledonian pine forest ride
NJ0181615387	Sweep net transects	Caledonian pine forest
NJ0189414469	Sweep net transects	Caledonian pine forest

Grid reference	Sampling method	Location description
NJ019160	Sweep net transects	Caledonian pine forest
NJ0268416065	Sweep net transects	Caledonian pine forest
NJ0277814911	Sweep net transects	Caledonian pine forest
NJ0303315705	Sweep net transects	Caledonian pine forest

3.1.2.8 *Formica exsecta*

A selection of 1 km squares where *F. exsecta* had been previously recorded was chosen for surveys carried out on 9, 12, 13 and 14 August on dry, sunny days when the ants would be active.

3.1.2.9 *Lepidoptera*

Previous records for *P. sobrina* are concentrated around Forest Lodge and other buildings that could power moth traps. Two locations, Tulloch Moor and Caledonian pine forest near Loch Garten (Figure 3.1, Table 3.2) were surveyed with a more portable (and so less restricted) heath trap on 31 July and 1 August, respectively. The locations and timings of the survey were derived from habitat and flight season noted by Waring & Townsend (2009).

Tulloch moor is dominated by ericoid shrubs with stands of juniper and birch and the trap was located at the transition between habitats to attract the maximum number of species (Figure 3.1). The section of Caledonian pine forest is over 30 years old and in close proximity to Loch Garten. The understory was predominantly made up of ericoid shrubs but also had a more open bog-wetland nearby containing purple moor-grass (*Molinia caerulea)* and birch (Figure 3.2). The traps were recovered in the morning with specimens being photographed and released.

Table 3.2. Lepidoptera sample locations at Abernethy Forest

Grid reference	Sampling method	Location description
NH9644316439	8V Heath trap	Tulloch Moor
NH9776217594	8V Heath trap	Caledonian pine forest

3.1.2.10 *Odonata*

The 19 sites identified in the 2002 SCM (Edgar, 2002) were sampled for larvae and searched for adults on 2 and 29 June and 6 July (Figure 3.1). A final visit was made to ponds in the east of Abernethy, as these could not be accessed earlier due to capercaillie counts in mid-summer. The weather on all these days was sunny, between 15 to 20 ºC.

3.1.3 Results

The most speciose groups of invertebrates we collected at Abernethy Forest were spiders and beetles, which yielded 56 species and 30 species respectively. A list of all invertebrate records is provided in a document accompanying this report.

3.1.3.1 *Terrestrial invertebrates (excluding* F. exsecta*)*

Of the spider species listed in the citation, only *C. subsultans* and *D. elevatus* were found. Nest boxes proved to be an excellent method for collecting *C. subsultans,* which was found on 1 August at both sample locations. It is interesting to note this nest box method proved to be very effective at collecting female *C. subsultans*, but did not detect any males. On the

other hand, the bark trapping used at Black Wood of Rannoch resulted in a male *C. subsultans*. This may reflect the more mobile behaviour of adult males when searching for mates, which would make bark traps more effective, whereas the more sedentary females would be more likely to inhabit the artificial nest boxes.

Dismodicus elevatus was found at three sample locations, NJ0183215937 (one female on 20 June in a bark trap), NH9643416421 (five females on 31 July captured using a variety of survey techniques) and NJ019160 (one female on 19 June by sweep net).

We also collected three male *Pardosa lugubris* (lugubrious wolf-spider) in pitfall traps at NJ0301815185 on 20 June (Figure 3.3). *Pardosa lugubris* has yet to be assigned a formal conservation designation, but is currently only known from a handful of Caledonian pine sites in the Scottish Highlands. It was, however, found to exist in considerable numbers in Abernethy Forest in 2004, and is also known from a single record at a woodland site in England (Harvey, 2004). *Pardosa lugubris* has recently been separated from another species *Pardosa saltans* (Töpfer-Hofman *et al*., 2000), and examination of British specimens of *P. lugubris* proved them to be *P. saltans*.

The beetle *A. tristis* and bug *E. fenestratus* were not found. The habitat surveyed and in the wider area is in good condition, so it is likely that these species are still present. We did find four other species of nationally scarce beetles: *Dictyopterus aurora* (golden net-wing), *Otiorhynchus scaber* (a broad-nosed weevil), *Pterostichus oblongopunctatus* (a ground beetle) and *Trechus rubens* (a ground beetle).

Dictyopterus aurora is associated with deadwood and found in the Caledonian forest in the Scottish Highlands. A specimen was collected by sweep net on 19 June at NJ019160 (Figure 3.4).

Otiorhynchus scaber has a variety of food plants, including birch, alder (*Alnus* spp.) and pine. It is predominantly arboreal and nocturnal. Specimens were found in a bark trap (NJ0216416812 on 20 June) and a sweep net transect (NJ0181615387 on 21 June). The bark trap was north of Forest Lodge in a compartment of 20 year-old plantation woodland. The woodland at this location has a monotonous ground flora consisting primarily of grasses and mosses, and little light reaches the ground. The crowded trees are thin, tall and straight. The woodland at the site of sweep net transect was much more open and older, with a diverse ground flora dominated by heather and blaeberry.

Pterostichus oblongopunctatus is thought to be widespread and abundant throughout the site. It was found at all three pitfall trap transects: 43 specimens in a very wet part of the Caledonian pine forest where the ground flora was dominated by *Sphagnum* spp. and *Eriophorum* spp. (NH9634917699 on 19 June), three specimens in a drier, grass-rich habitat within Caledonian pinewood (NH9994617412 on 20 June) and 17 specimens in a heather-blaeberry ground flora with a marshy area nearby (NJ0301815185). An example of the habitat in which this species was found is shown in Figure 3.5.

Trechus rubens is a northerly species associated with moorland moss and woodland litter in which we collected our specimens; four were found on 31 July on bugvac samples. It was also found in moorland at Loch Eaniach in Cairngorms during our 2013 surveys.

One *O. uncinata* specimen was collected on 19 June at NH9807819499 by sweep net transects in the north of Abernethy Forest. It was feeding on common bird's-foot-trefoil on an open woodland ride. Recent deforestation of the compartments on either side of the ride has increased brightness and warmth, and will eventually aid plant re-colonisation. The felled trees have been left in piles, which are ideal for solitary bee nests.

3.1.3.2 *Formica exsecta*

Formica exsecta was recorded in all nine 1-km squares chosen for survey (Figure 3.2).

NJ0116: this 1 km square contained areas of bog woodland and open glades within Scots pine on the eastern side of the forest track. The wet nature of the habitat restricted tree growth and therefore maintained an open canopy (Figure 3.6). Hummocks provided suitable sites for nest mounds, and seven active *F. exsecta* nests were found. Other areas of this square, particularly on the west side of the track, were densely wooded and were not included in the survey as they were not considered suitable for *F. exsecta*.

NJ0016: this area consists of Scots pine forest with a varied structure, ranging from dense plantation and bog woodland to open canopy areas with mature juniper. Only one nest of *F. exsecta* was located and dense tree growth is likely to have made the area generally unsuitable. Four nests of *F. sanguinea* (the slave-maker ant) were found in a glade containing mature juniper. This habitat would be suitable for *F. exsecta,* but competition from *F. sanguinea* has probably prevented them from colonising. *Formica sanguinea* is likely to be common in this area, with nests potentially being overlooked during the survey.

NJ0117: open glades within forest with large hummocks and mossy vegetation provided suitable habitat for *F. exsecta* (Figure 3.7). A large glade on the eastern side of the track was particularly good; deer grazing levels provided grassy pockets amongst the heather which *F. exsecta* is known to favour (i.e., Tulloch Moor). Nine nests were located here. Some tree regeneration and bracken (*Pteridium aquilinum*) growth is occurring within the glades, but these are not considered immediate threats to nests.

NJ0115: this area, close to the River Nethy, provides good habitat with open, hummocky ground, but no nests were found. Bracken was beginning to encroach significantly, which could cause this habitat to become unsuitable over time. Nests may have been present but overlooked. We found five nests around the telegraph way-leave on NJ0115 (Figure 3.8), an area with previous records. Two nests were found within the way-leave, although it is likely that more were overlooked. Signs suggested that maintenance work was carried out recently; vehicle tracks were seen and one nest looked trampled and badly damaged. Some nests recorded for the edge of the way-leave were not found, as the habitat had become too shaded. Although the telegraph way-leave is likely to remain suitable for *F. exsecta* due to removal of trees, the habitat around the way-leave is experiencing regeneration and nests are unlikely to persist due to over shading.

NJ0018: this 1 km square contained a mixture of bog woodland and Scots pine with an open canopy and pockets of Scots pine plantation. Generally the habitat was good for supporting *F. exsecta*. We found nine nests: some were located in grassy glades within woodland while others were in boggy habitat with scattered trees.

NJ0214 and NJ0215: these 1 km squares include the ruins of Inchtomach and surrounding habitat. There is a large opening in the forest on the eastern side of the River Nethy comprising of wet, marshy habitat in a low lying area with heath on higher ground. There are scattered mature Scots pine and juniper with younger trees and bracken becoming established in some areas. We found 17 active *F. exsecta* nests, with the majority on a south-facing bank below Inchtomach. Some bracken was encroaching on the area containing a large number of *F. exsecta* nests.

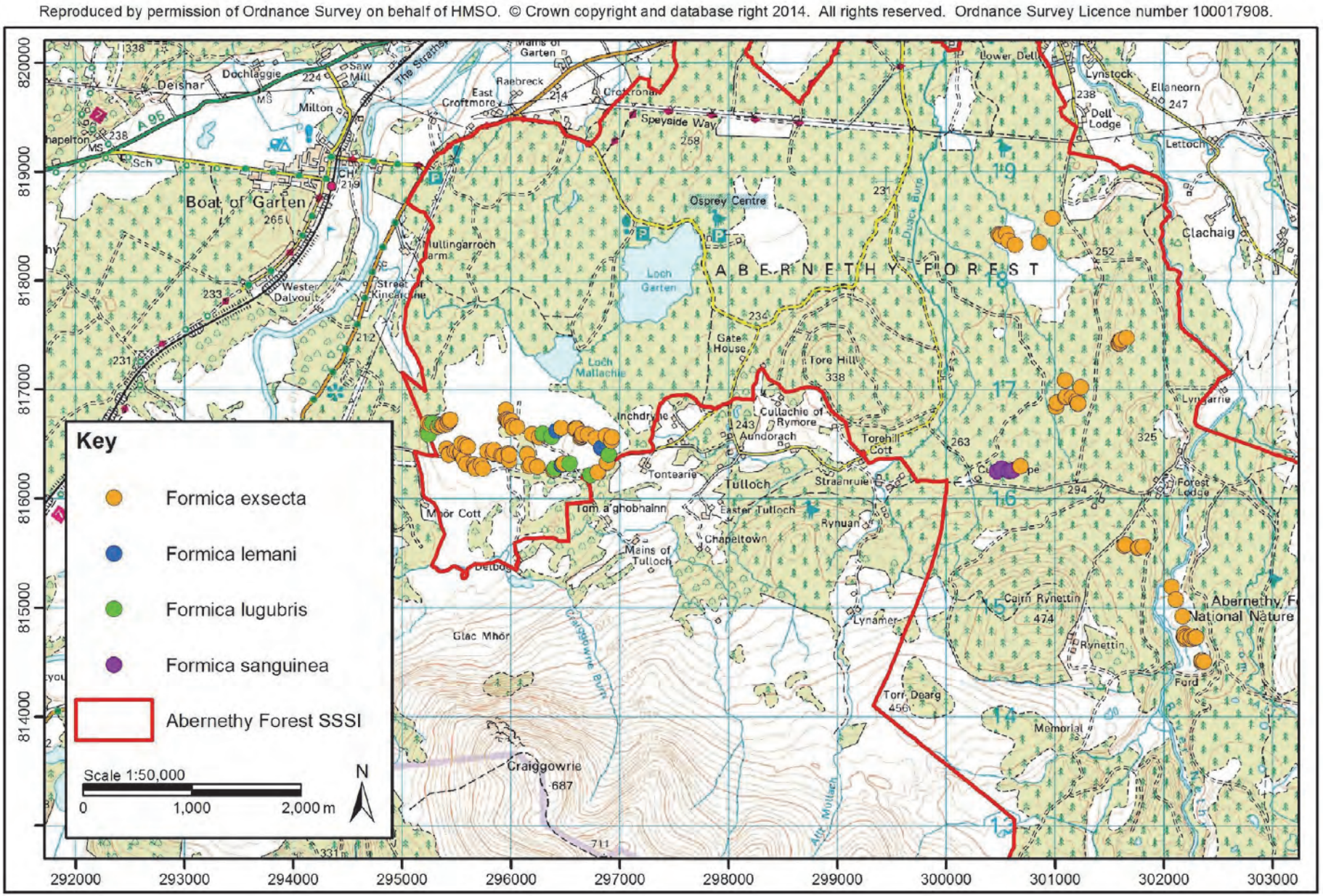

Figure 3.2. Ant nest locations in Abernethy Forest SSSI

NH9516 and NH9616 (Tulloch Moor): we recorded 73 active nests in this area of heathland, mixed woodland and scattered trees on the western edge of the SSSI. This figure is likely to be an underestimate, as over 100 nests have been previously recorded here. Muir burning is taking place to maintain heath habitat and one *F. exsecta* nest was found in an area likely to have been burned in the same year. However, the nest was still active, although burning removes ants' immediate food supply. Juniper is present on Tulloch Moor, particularly on the eastern side, and this is known to be used be *F. exsecta* as foraging habitat.

In general, *F. exsecta* nests seem to be mainly concentrated in areas of Tulloch Moor where there is a mosaic of grassland and heather (Figure 3.9).

We found that *F. lugubris* (the hairy wood ant) is also abundant on Tulloch Moor. This species also favours glades and woodland edges and could compete with *F. exsecta* for habitat. However, under the current management regime, there should be plentiful habitat to support both species. *Formica lemani* (the black ant) was frequently recorded in areas where *F. exsecta* was found, so host availability is not thought to be a limiting factor at this site.

3.1.3.3 *Lepidoptera*

Protolampra sobrina was confirmed from two specimens caught at each moth trapping on 31 July (NH9644316439) and 1 August (NH9776217594). Both sites fit the habitat description for the species (Waring & Townsend, 2009: a more open habitat is preferred where *P. sobrina* is associated with young birch shrub).

We also found four other Scottish biodiversity list moths: *Noctua orbona* (lunar yellow underwing) – also nationally scarce, *Acronicta psi* (grey dagger), *Blepharita adusta* (dark brocade) and *Diarsia rubi* (small square spot).

Noctua orbona and *D. rubi* were both found in the denser forest near Loch Garten (NH976217594) on 1 August. *Noctua orbona* uses a variety of grasses as larval food plants, generally in drier situations, whereas *D. rubi* uses a range of herbaceous plants as well as heather, and is most abundant in damp woodland (Waring & Townsend, 2009). The survey location bordered on more marshy habitats, but it was largely dry underfoot with a more open area of regeneration within the forest which fits the habitat requirements of both species.

Acronicta psi and *B. adusta* were found in the more open Tulloch Moor (NH9644316439) on 1 August. *Acronicta psi* feeds on a wide range of broadleaf trees and shrubs and is found in woodland and heath habitats (Waring & Townsend, 2009). *Blepharita adusta* uses a variety of woody and herbaceous plants as larval food plants, and is found in moorland and grassland habitats (Waring & Townsend, 2009). This site meets the habitat requirements of both species.

In total, 43 species of moth were recorded at Abernethy Forest.

3.1.3.4 *Odonata*

In total 19 sites were visited, and 10 Odonata species were recorded (Table 3.3). *Coenagrion hastulatum* was found at five of the original eight ponds, with two additional sites. The site names follow Edgar (2002).

Table 3.3. List of Odonata species recorded in Abernethy Forest compared with species previously recorded from this area.

Species	2002 SCM	2013 SCM
Aeshna caerulea (azure hawker)*		
Aeshna juncea (common hawker)	X b	X b
Coenagrion hastulatum (northern damselfly)	X b	X b
Cordulegaster boltonii (golden-ringed dragonfly)	X	X
Cordulia aenea (downy emerald)		
Enallagma cyathigerum (common blue damselfly)	X b	X b
Lestes sponsa (emerald damselfly)	X b	X b
Leuchorrhinia dubia (white-faced darter)	X b	X b
Libellula quadrimaculata (four-spotted chaser)	X b	X b
Pyrrhosoma nymphula (large red damselfly)	X b	X b
Somatochlora arctica (northern emerald)	X b	X b
Sympetrum danae (black darter)	X b	X b
Ischnura elegans (blue-tailed damselfly)		X b
Sympetrum striolatum (common darter)		
Total	10/9 b	11/10b

X = present; b = evidence of breeding
** Records for this species are questionable for this area*

Abernethy Dell Woods NJ009185: This site has two peaty pools lying in a heathery area with some Scots pine regeneration and larger pines on dryer knolls nearby (Figure 3.10). These ponds were in poor condition and it looked like they had dried out this year. These were visited on 29 June. *Coenagrion hastulatum* was not recorded and is not thought to be breeding at this location, although it was recorded before or during the 2002 SCM (Smith & Smith, 1996; Edgar, 2002).

Pond 1.5 km North of Ryvoan Bothy NJ009131: This is a small pond of around 15 m in diameter, lying next to a track (Figure 3.11). This pond is now completely overgrown with sedges and holds very little water. Only *Sympetrum danae* was seen. *Coenagrion hastulatum* was not recorded, and is not thought to be breeding at this location, although it was recorded before or during the 2002 SCM (Smith & Smith, 1996; Edgar, 2002).

Caravan Pond NH966193: This site is a deep lochan of approximately 40 m diameter created by the RSPB by damming the outflow of a burn (Figure 3.12). Two *C. hastulatum* larvae were found (28 June), as were three males and a pair in tandem (6 July). Breeding was confirmed.

Alden Lodge Pond NH954191: This pond was created by the RSPB (3.13). No *C. hastulatum* were found on 28 June or 6 July. However in 2006 J Willet saw three adult males and one adult female so they were present since the last SCM cycle (Smith & Smith, 1996; Edgar, 2002).

East Croftmore NH959195: This is a very boggy area with little open water (Figure 3.14). Seven *C. hastulatum* larvae were found on 28 June and four adults and four larvae were found on 6 July. This confirms breeding at this site, although it is worth noting that J Willet saw no *C. hastulatum* here in 2006, suggesting the area may have been recolonized since then.

Ridge Pool NH966182 This is a lochan in a forest bog (Figure 3.15). *Coenagrion hastulatum* were found here on 28 June (10 adults).

Mid-Garten Wood Marsh NH962183: This is an area of bog approximately 120 x 40 m created by the RSPB in the late 1980s by damming a forest drain (Figure 3.16). A single male *C. hastulatum* was found on 28 June.

Mullingarroch Farm Marsh NH953181: This is an area of bog land (300 x 50 m), which was dammed and flooded by the RSPB in the 1980s (Figure 3.17). Two male *C. hastulatum* were found on 29 June.

Mullingarroch Forest Bog NH9630718264: This is a typical forest bog with a rich sphagnum carpet fringing the open water (Figure 3.18). One male *C. hastulatum* was found on 26 June. This site was not included in the 2002 SCM and therefore it is a new *C. hastulatum* site.

Leucorrhinia Pool NH982175: This is a deep, sphagnum-covered pool formed through old peat cuttings (Figure 3.19). Breeding evidence of *Leuchorrhinia dubia* was found on 28 June.

Gate House Wood centred around NH980172: This is an area of forest bog of varying degrees of wetness (Figure 3.20). It is very extensive and the previous site is part of the most accessible part of this complex. Breeding evidence of *L. dubia* and *Somatochlora arctica* was found on 6 July.

Loch Mallachie – Loch Garten ditch/drain NH967173: This is a deep ditch linking the two lochs containing some emergent plants (e.g. *Potamogeton* spp.) (Figure 3.21). Three male *C. hastulatum* were found on 28 June. The species was recorded on this site in 1978 but was not found in the Smith & Smith (1996) surveys or in 2002.

Inchtomach/River Nethy NJ020153: This is a marshy area on either side of the River Nethy (Figure 3.22). It includes a series of small burns and ditches running into the river. This site was not surveyed due to lack of suitable habitat.

Clais an Eich Wood lochan NJ014137: This is a sheltered lochan with the edge of a plantation running along the south side and Scots pine regeneration to the east and northeast. Due to unsuitable habitat, the nearby Rynettin Lochans were surveyed instead.

Tulloch Moor Lochans NH961163: This is a series of lochans surrounded by birch trees (Figure 3.23). Four Odonata species were recorded on 29 June.

Tulloch Moor Peat Cuttings NH959168: This is a series of pools formed as a result of peat cutting (Figure 3.24). Breeding evidence of *L. dubia* and *S. arctica* was found on 29 June.

Pylon Line – Garten Wood NH953184: This is an area of heather and grassy tussocks and wetter, marshy ground with small drains and burns (Figure 3.25). *Libellula quadrimaculata* was seen on 29 June.

3.1.4 Site condition evaluation

3.1.4.1 *Araneae*

Although we did not find *D. torva*, *P. elongata*, *H. soerenseni* or *N. sarcinatus*, the site offers ample suitable habitat for all species, and there is no sign of deterioration (as evidenced by the diverse spider and beetle fauna found, which are associated with the same habitat as these target species). The abundant wood ant populations also mean there is sufficient prey for the specialist *D. torva*. Therefore, there is no reason for these species not to persist.

We did find *P. lugubris.* Although its status is not yet known, it appears to be rare and largely associated with Caledonian forest (Harvey, 2004).

3.1.4.2 *Coleoptera*

Although we did not find *A. tristis*, Abernethy Forest offers a wide range of deadwood habitats. The RSPB actively enhances the availability and diversity of this resource (Cathrine & Amphlett, 2011). Therefore, there is no reason for this species not to be extant.

We did find four species of nationally scarce beetle, which indicates that the site offers good quality woodland habitat, as well as more open heath and wetter habitats. This supports the assessment that habitat remains suitable for species of invertebrates included in the invertebrate assemblage description.

3.1.4.3 *Hemiptera*

Although *E. fenestratus* was not found, the site offers ample supplies of juniper (Figure 3.1). Indeed moth trapping revealed several species associated with this plant such as *Eupithecia pusillata* (juniper pug) and *Thera cognata* (chestnut-coloured carpet). There is, therefore, no reason for this species not be extant.

3.1.4.4 *Hymenoptera*

Tulloch Moor and Inchtomach had the densest populations of *F. exsecta* nests in the areas covered during this survey. These areas are generally open habitat with only scattered trees. In other areas surveyed, woodland cover is changing (which is a natural process) but this may not favour the ants, particularly where suitable habitat is not being replaced (i.e. open glades are not being created). Some historic nests have been lost in areas where woodland has shaded nests. Bog woodland appears to be important for *F. exsecta* as the trees are stunted and the canopy is open. Wet areas are, however, generally suboptimal, and drier areas of woodland are preferred as the ground warms up faster in the summer months (Hughes, 2006). Bog woodland is likely to provide *F. exsecta* with a refuge from changing woodland cover and competition from other wood ants.

Inchtomach is favourable for supporting *F. exsecta* due to the openness of the habitat and the presence of grass/heath mosaics. There are significant stands of bracken beginning to form, however, and one *F. exsecta* nest was within 1m of the edge of an area of bracken. Bracken will render the habitat in this area unsuitable for *F. exsecta* if it is not monitored and managed appropriately.

Tulloch Moor is considered to be favourable habitat for *F. exsecta*. This is due to the openness of the habitat combined with scattered trees and juniper that provide enough shelter and food. This area is managed for black grouse, which is likely to benefit *F. exsecta*. Nests in the north-west corner (NH9516) are, however, exposed to high levels of regeneration. As long as care is taken to avoid damaging many nests, muir-burning on Tulloch Moor will benefit *F. exsecta* and other ant species by creating habitat mosaics of different ages and will prevent the heath from becoming tall and over-mature. Older heath makes it difficult for ants to colonise due to shading. The areas of Tulloch Moor most densely populated by *F. exsecta* appear to be grassy pockets amongst the heath. This mosaic of grassland and heathland should be maintained and encouraged as this will also benefit a range of other invertebrate taxa, such as Lepidoptera.

The site supports ample populations of *Osmia uncinata* food plants, and recent deforestation has increased brightness and warmth in the area. This is likely to aid re-colonisation. Furthermore, felled trees have been left in piles which are ideal for solitary bee nests.

3.1.4.5 *Lepidoptera*

The site continues to offer suitable habitat and food plants for *P. sobrina*. The 43 species of moth including four of conservation importance indicate a diverse Lepidoptera community.

3.1.4.6 *Odonata*

It should be noted that the area of pools to the east of the River Nethy cannot be accessed until the Capercaillie brood counts have been completed in July, so early visits for pre-emergence larval sampling were not possible. We suspect, however, these sites are at too high an elevation for *C. hastulatum* to breed regularly. From J. Willet's surveys this year, Willet (2009) and records on the NBN, it appears that the core areas in Speyside are below 250 m elevation.

In the forest bog habitat, *C. hastulatum* was found on sites with suitable deep water pools and appeared in reasonable numbers at some locations. This is not the typical habitat for this species, which tends to prefer shallow pools or lochans often with a regulated water level (Smith & Smith, 1996). However, it was impossible to sample these sites for larvae as the sphagnum mat was too thin to safely walk on.

The numbers of larvae and adults were not particularly high, but we do not think that this accurately reflects the size of the population. The Caravan Pool in particular is a very reliable site for seeing large numbers of this species. Two of the eight 2002 SCM sites are now not suitable habitats for *C. hastulatum*: the pool near Ryvoan Bothy was completely covered by vegetation and the Dell Woods pool had dried out. With such a large number of potential sites, however, this does not influence the site overall.

The site also supported a good number of other Odonata species, including *S. arctica* and *L. dubia*, and offers diverse habitats for a range of species contributing to the invertebrate assemblage feature.

3.1.5 Site management recommendations

3.1.5.1 *Araneae*

The site offers a wide variety of high quality habitats, and no specific management is recommended for Araneae. Ensuring the high quality and diversity of habitats will benefit this group, and management for *F. exsecta* will benefit *D. torva* in particular. Surveys have shown that spider nest boxes are effective at detecting *C. subsultans*, although all specimens collected were female. We would recommend this method for future monitoring for this species, although it should be used in combination with bark traps if possible in order to increase the likelihood of collecting male specimens.

3.1.5.2 *Coleoptera*

The site offers a wide variety of high quality habitats, and no specific management is recommended. Ensuring the high quality and diverse habitats will benefit this group, and management of deadwood habitats will benefit *A. tristis* as well as other saproxylic species such as the nationally scarce *D. aurora*.

3.1.5.3 *Hemiptera*

The spread of juniper should be encouraged, and this will also benefit other species such as *F. exsecta*.

3.1.5.4 *Hymenoptera*

The results of this survey suggest that a comprehensive survey of the entire site is needed in order to provide a more accurate picture of the status of *F. exsecta*. Previously recorded nests still exist, but a significant number were not located suggesting that habitat has changed considerably since the last exhaustive survey conducted in 2000-2001 (Jones, 2009).

We recommend maintaining open pockets around nests and, if possible, providing additional adjacent open areas to allow nests to spread.

Care must be taken during muir-burning to avoid *F. exsecta* nests, although this survey revealed that in some cases these can survive (most likely in light, fast burns). This method of habitat management is likely to be beneficial in the long-term by creating a mosaic of habitats and providing a continuous supply of open, short sward habitat which *F. exsecta* favours.

Power line and telegraph way-leaves provide habitat for this species as these are managed to avoid canopy closure. There are, however, signs that some nests have been trampled and damaged during management along way-leaves. As such, measures such as 'tool box talks' and marking *F. exsecta* nests and advising contractors of a suitable set-back distance should be taken.

The spread of juniper on Tulloch Moor should be encouraged as this provides food and shelter for *F. exsecta*. Periodic burning will encourage juniper to regenerate and prevent stands from becoming dense and overgrown, which may potentially shade nests, rendering habitat unsuitable.

Open glades and rides should be maintained to provide suitable habitat for *O. uncinata*. Further research is required to determine the nesting requirements of this species.

3.1.5.5 *Lepidoptera*

There are no group specific management recommendations to be made.

3.1.5.6 *Odonata*

The site is in good condition for Odonata overall. The clearance work by the RSPB on the smaller pools near Loch Garten should continue, as should any further plans to block drainage channels in historically drained wetlands throughout the site.

3.2 Alvie

3.2.1 Site description

Alvie SSSI covers 339 ha and includes a large area of native woodland, open water and wetland habitats. The site supports extensive mixed birch woodland, including downy (*Betula pubescens*) and silver birch (*B. pendula*) associated with a variety of other species including aspen (*Populus tremula*), rowan (*Sorbus aucuparia*), Scots pine, oak (*Quercus petraea*) and juniper. Scots pine is dominant to the west of the site, while a stand of pure oak woodland to the south represents one of the few occurrences of oak in mid Strathspey. Wet birch and alder woods with willow scrub also occur around Loch Alvie and Loch Beag. The site includes Loch Alvie, Loch Beag and Bogach, which are surrounded by large areas of inter-connected wetland habitats including aquatic communities, reed beds, deep-water transition swamps, marginal swamps, transition mire, fen meadow and carr woodland. The

range of fen and mire communities is outstanding, with over 20 types of vegetation communities.

The site supports a number of biological features, including upland oak woodland, hydro-morphological mire range and breeding goldeneye (*Bucephala clangula*), as well as the invertebrate assemblage.

Summary of known invertebrate interests

3.2.1.1 *Diptera*

Hammerschmidtia ferruginea (aspen hoverfly) RDB1
Hammerschmidtia ferruginea is listed as 'Critically Endangered' in the Red Data Book and recognised as a priority species in the UK Biodiversity Action Plan. The species is confined to seven sites across the Scottish Highlands, particularly Strathspey, with outlier populations in Ross-shire, Sutherland and Deeside (Rotheray & MacGowan, 2000). The larva is found in wet decaying cambium that builds up under the bark of recently fallen or dead standing trunks and branches of aspen with a diameter of at least 30 cm. They feed on bacteria that bloom in the decaying sap and extract their prey through filtration of the oily liquid, similar in manner to the baleen whales and their planktonic prey (Rotheray, 1990). Such breeding sites are, however, ephemeral: when a branch or tree falls, decaying sap develops patchily across the deadwood over a two year period, and is only suitable for the larvae for one to four years prior to the bark falling off and the sap drying up. Dead wood tends to remain suitable for longer if it exceeds 30 cm diameter and is able to retain moisture (in shade or in complete contact with the ground, rather than partially fallen). In the absence of suitable dead wood, the fly may persist over a few years in sap runs on live trees. However, this is a poor substitute and cannot support sustainable populations in the longer-term (Rotheray & MacGowan, 2000).

Between 1990 and 2006, the number of localities where the aspen hoverfly was detected dropped from 13 to five, then went back to eight. These fluctuations were linked to the varying amounts of dead wood deposited by intermittent storm and wind events over the years. In addition, although aspen is a common tree in Scotland, it rarely occurs in stands greater than 5 ha. Since 12 of the 13 known aspen hoverfly sites included woodlands exceeding 5 ha, it is thought that inputs of dead wood and the number of sap runs are continuous and high enough for populations to persist (Rotheray *et al.*, 2009). The temporary and restricted nature of the larval habitat is the primary factor limiting population recovery.

Hammerschmidtia ferruginea was first recorded from Alvie SSSI in 1982 and intermittently until 2011 by the Malloch Society. Since 1982, the Malloch Society has recorded the amount of dead wood available to *H. ferruginea* and has found this to be relatively low and even absent in some years. The aspen available is limited, covering just 2 ha, and is the only known site under 5 ha where *H. ferruginea* has been recorded over multiple years (Rotheray *et al*., 2009).

3.2.1.2 *Coleoptera*

Donacia aquatica (zircon reed beetle) RDB3
This brightly coloured leaf beetle (Family Chrysomelidae) is found in sedge (*Carex* spp.)-dominated aquatic vegetation by open water, or with rushes around upland corrie pools and tarns. Eggs are laid at the base of sedges where the larvae and pupae develop. The adults are active until midsummer with an occasional resurgence in autumn. The larvae are aquatic, feeding below the surface on parts of vegetation. The adults are active in good weather during May and June, and may occasionally be found up to early July.

3.2.1.3 *Mollusca*

Vertigo lilljeborgi RDB3
Vertigo lilljeborgi is a minute whorl snail (about 2 mm in size) that inhabits decaying vegetation at edges of basic or buffered water bodies. It is classified as RDB3 (rare), and considered to be declining by Cameron & Killeen (2001). This species was first recorded at Alvie by Ian D. Finney in 1967 at NH863092 on the east side of Loch Beag (Foster, 1983). Its status at Alvie does not appear to have been assessed since its discovery.

3.2.1.4 *Trichoptera*

Hagenella clathrata (window winged sedge) RDB1
This very rare caddisfly lives in small pools on bogs and heathland. These pools must be shallow and lie beneath dense tussocks of purple moor-grass and may dry considerably by midsummer. Trees (particularly birch) and shrubs are apparently important, providing food and case-making material for larvae and swarming sites for adults (Wallace, 2011). Small pools between tussocks, often over shaded, are also required (David Pryce, pers. comm.; Wallace, 2011). The adult flight period in Scotland is late June to early July. It was recorded at Alvie on 23 June 1967 by Ted Pelham-Clinton. This record is, however, labelled as being from Kinrara, and has only a 10 km grid reference. The species has also been recorded from the nearby RSPB Insh Marshes reserve 1982 (Wallace, 2011).

3.2.2 Methods

Fieldwork was completed in 2013.

3.2.2.1 *Diptera*

We surveyed Alvie SSSI on 15 April. The majority of aspen was located in several small clusters across the grid square NH845085. This habitat was walked over and trees inspected for evidence of sap runs and fallen dead wood exceeding 30 cm diameter. Suitable dead wood was ‘point sampled’ for the early stages (larvae and puparium). This involved lifting the dead bark at several points so as to limit disturbance to the habitat.

In addition, the amount of decaying wood (suitable habitat for larvae) and freshly fallen wood (potential larval habitat in future years) were counted across the site. Fallen trees that could be breeding habitat were also noted. Data gathered during the current fieldwork was supplemented by historic data from published sources and fellow entomologists to gain an overall picture of site condition over the years.

3.2.2.2 *Terrestrial invertebrates*

A visit was made on 1 July to coincide with the *Donacia aquatica* population peak. Loch Alvie was targeted for survey, where there was ample bankside and emergent vegetation. Where safe, stable vegetation rafts were also surveyed. Sweep net transects were used to collect the beetle from the leaves of sedges and reeds lining the loch (Figure 3.3). We also recorded terrestrial invertebrates collected during sweep net, beating and bugvac surveys for *H. clathrata* on 15 and 16 July (Table 3.4).

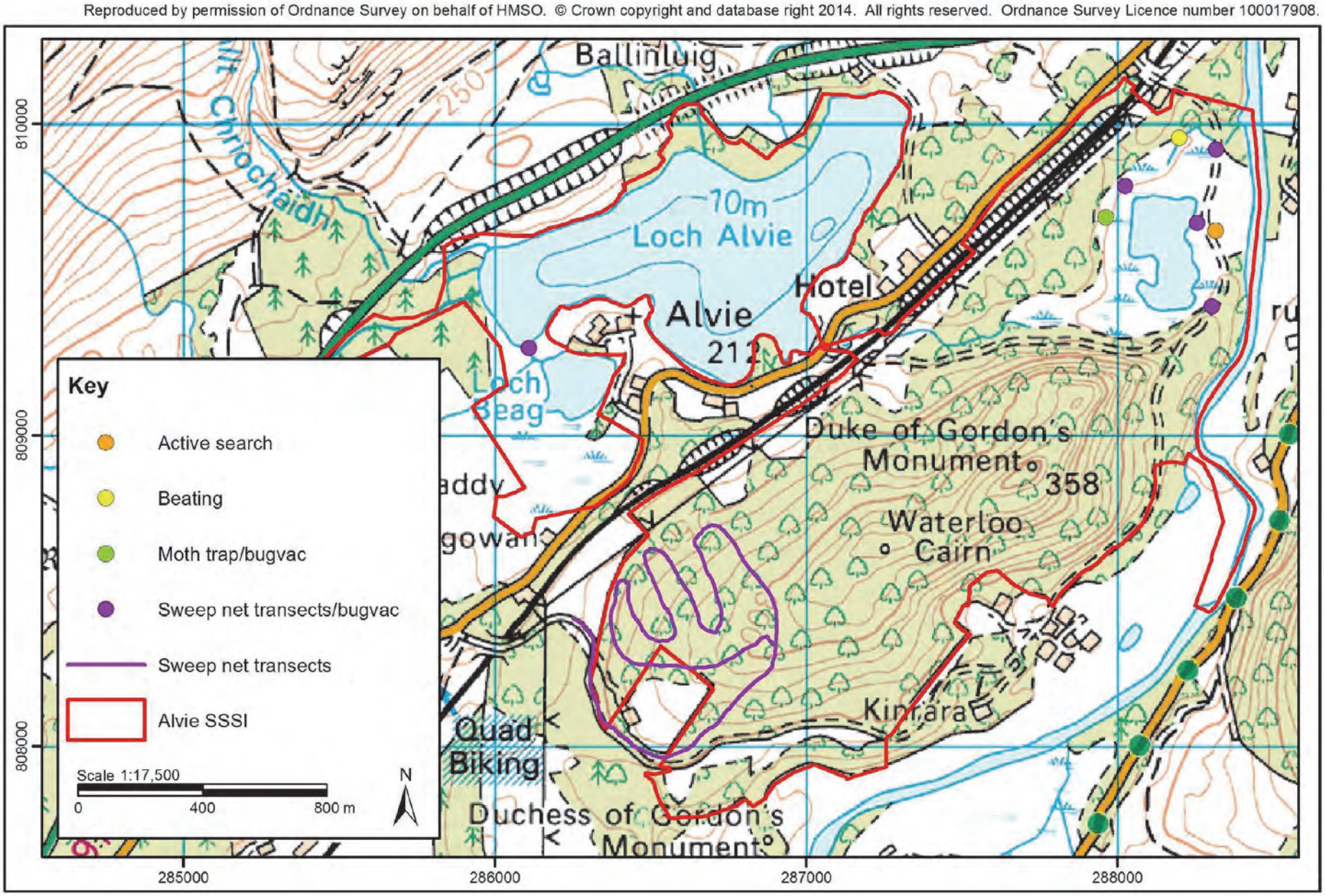

Figure 3.3. Survey locations in Alvie SSSI (excluding Mollusca)

Table 3.4. Terrestrial invertebrate and Trichoptera sample locations at Loch Alvie

Grid reference	Sampling method	Location description
NH8831509656	Active search	Dried out pond colonised by grasses
NH8819909955	Beating	Scots pine adjacent to marsh
NH8802509800	Bugvac	Fen with reed/sedge vegetation raft adjacent to birch woodland
NH8825609682	Bugvac	Fen with reed/sedge vegetation raft adjacent to birch woodland
NH8796309699	8V Heath trap	Fen with reed/sedge vegetation raft adjacent to birch woodland
NH8611009281	Sweep net	Sedge vegetation raft
NH8802509800	Sweep net	Fen with reed/sedge vegetation raft adjacent to birch woodland
NH8825609682	Sweep net	Bankside reed/sedge vegetation
NH8830309414	Sweep net	Bankside reed/sedge vegetation
NH8831709918	Sweep net	Vegetation adjacent to stream

3.2.2.3 *Mollusca*

We visited Loch Alvie on 6 July and sampled a range of loch-side locations with decaying vegetation that appeared to be suitable for *V. lilljeborgi.* The only known previous record from 1967 was from the east side of Loch Beag (according to the grid reference NH863092). As assessment of *V. lilljeborgi* in the field would be impractical, we sampled a range of local environments to maximise likelihood of collection for lab identification. We took five samples from around the edge of Loch Beag, in reed/rush litter near the northern shore, and occasionally-inundated sedge tussock litter near the western shore. We took two other samples of sedge/moss litter from the mire separating Loch Beag from Loch Alvie, and three from the sandy/gravelly south shore of Loch Alvie. Sample locations are summarised in Table 3.5 and Figure 3.4.

Table 3.5. Mollusca sample locations at Loch Alvie

Grid reference	Location description
NH8621309257	Phragmites fen, near north shore of Loch Beag
NH8621309257	Phragmites fen, near north shore of Loch Beag
NH8617309240	Quaking sedge mire between Loch Beag & Loch Alvie
NH8611609247	Quaking sedge/rush mire by Loch Beag outflow to Loch Alvie
NH8613909166	Occasionally-inundated tussock sedge marsh west of Loch Beag
NH8616109161	Coves in sedge tussocks on west shore of Loch Beag
NH8616309321	Beach litter, southwest shore of Loch Alvie
NH8625009401	Sedge/rush beach litter on south shore of Loch Alvie
NH8650409385	Sedge litter/mud on south shore of Loch Alvie
NH8636009107	Alder/rush/reed litter on rocky southeast shore of Loch Beag

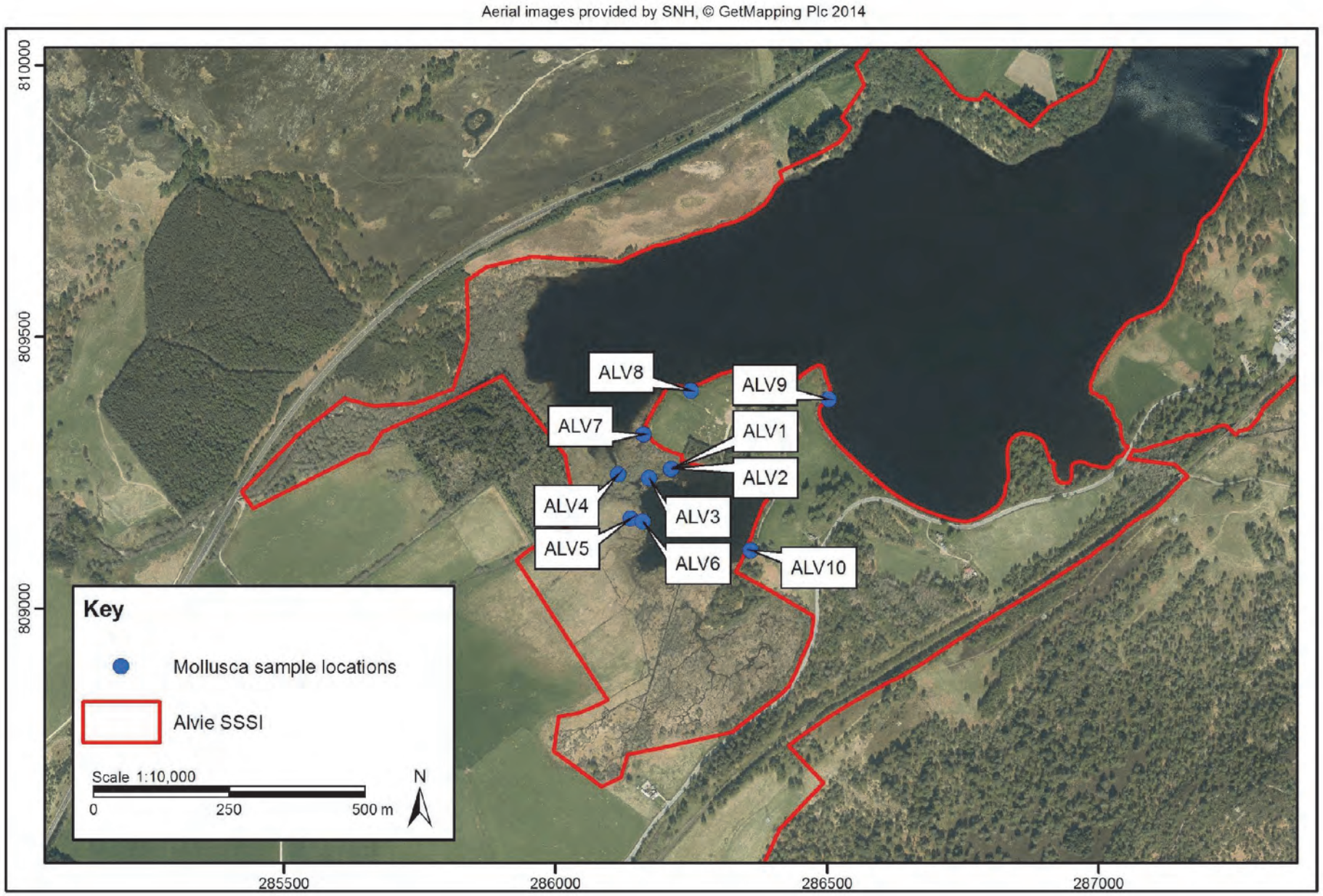

Figure 3.4. Mollusca survey locations in Alvie SSSI

3.2.2.4 *Trichoptera*

We completed sweep net transects to survey for *H. clathrata* around the edges of Bogach, on the Kinrara Estate. This location was selected as offering the best possible habitat for this species, with birch and ample pools between tussocks surrounding the lochan. We targeted emergent and bankside vegetation and the lower branches of nearby trees as recommended by David Pryce (pers. comm.). In addition to sweeping, bugvac sampling was used in several locations around the lochan to collect any specimens that dropped to the thicker tussocks or the base of trees. A heath trap was left overnight to attract any caddisflies missed by the previous active sampling (Figure 3.3). Due to the suboptimal weather during spring and slow start to summer, the survey visits were not completed until 15 and 16 July. It should also be noted that we were unable to survey all potential areas of suitable habitat due to access limitations as a result of an osprey nest.

3.2.3 Results

3.2.3.1 *Diptera*

No puparia or larvae of *H. ferruginea* were found in any of the fallen dead aspen. To prevent excessive damage to this scarce habitat, however, our searches were not exhaustive and specimens could have been overlooked. Fallen aspen wood was present throughout the site. The strong winds experienced across Scotland during the winters of 2010/11 and 2011/12 were probably responsible for the increased input of fallen dead wood.

The majority of fallen wood were small pieces of <20cm diameter. Much of the dead wood was, however, drying out and it is unlikely to be suitable breeding habitat in subsequent years. There were several pieces of large freshly fallen wood, including two uprooted trees at NH864083 and NH862087, with a diameter at breast height of ~30 cm, with the potential to become breeding habitat within the next two to three years (Figure 3.26).

There was some evidence of small-scale wood cutting and stacking for use as game bird shelters and for wood fuel. Decaying sap beneath bark quickly dries in stacked piles and becomes unsuitable for *H. ferruginea* breeding. Removal of dead wood from the site, even at a small scale, further reduces this scarce resource.

It appears that much of the site suffers from extensive sheep grazing that may be exacerbated by deer. This grazing pressure is likely to be responsible for the suppression of aspen regeneration (Figure 3.27). In the long-term the number of aspen trees at the site may slowly decrease as mature trees perish without being replaced.

3.2.3.2 *Terrestrial invertebrates*

We collected seven *D. aquatica* specimens by sweeping a vegetation raft of sedges on the south-east bank of Loch Alvie (NH8825609682) on 1 July (Figure 3.28). This was the only part of Loch Alvie suitable for *D. aquatica* as the rest of the banks were cobbled to prevent erosion from fishermen.

The nationally scarce reed beetle *Donacia clavipes* was found in the same sweep net transect (NH8825609682). We also found two rare species of spider during surveys for *H. clathrata:* we collected a single female *D. torva* specimen by bugvac from the ground (NH8825609682) on 15 July and a single female specimen of *P. lugubris* by bugvac at NH8802509800 on 15 July. During the sweep net transects near Bogach (Figure 3.29), we found a single *C. hastulatum* specimen (NH8825609682) on 15 July.

The use of a moth trap to locate caddisflies did have the added value of allowing moth recording. Three rare moths were collected at NH8796309699 on 16 July; *Dichomeris juniperella* (Scotch crest), *P. sobrina* and *Spilosoma lubricipeda* (white ermine).

Dichomeris juniperella is an RDB1 micro-moth that feeds on juniper and is found in open woodland and on the lower slopes of mountains, with a distribution restricted to Scotland (Sterling & Parsons, 2012). We found a single specimen.

We found two specimens of *P. sobrina,* reported to prefer young birch scrub, which is certainly present on site – the area surrounding Bogach supports regenerating and stunted birch (Waring & Townsend, 2009). Heather and blaeberry, both larval food plants, are also present at Alvie SSSI.

Spilosoma lubricipeda food plants include nettles and docks. It is found in a wide variety of habitats (Waring & Townsend, 2009).

3.2.3.3 *Mollusca*

We identified *V. lilljeborgi* shells in four of 10 samples taken from a range of organic litter settings around the margins of Loch Beag and its outflow to Loch Alvie. One reed fen sample from the north of Loch Beag yielded three *V. lilljeborgi* shells, one sample from the mire separating Loch Beag and Loch Alvie yielded a single shell (Figure 3.30), and two samples from the sedge-dominated grazing marsh on the west of Loch Beag yielded 10 shells (Figure 3.31). These results are summarised in Table 3.6.

Table 3.6. Alvie Mollusca results. ad = adult; juv = juvenile

Sample	Habitat	*V. lilljeborgi*	Total mollusc spp.
ALV1	Phragmites fen litter		4
ALV2	Phragmites fen litter	1ad,2juv	6
ALV3	Quaking sedge mire	1ad	4
ALV4	Quaking sedge/rush mire		4
ALV5	Sedge tussocks	1ad,1juv	5
ALV6	Loch-side sedge tussocks	6ad,2juv	6
ALV7	Beach litter		4
ALV8	Sedge/rush beach litter		2
ALV9	Sedge litter/mud		6
ALV10	Rocky shore litter		4

The most frequently-encountered mollusc was the bivalve *Pisidium personatum* (which was found in eight samples). Two other bivalves (*P. milium* and *P. nitidum*) and two freshwater snails (*Galba truncatula* and *Gyraulus albus*) were present in half or more of the samples. Other than *V. lilljeborgi,* no rarities were identified.

3.2.3.4 *Trichoptera*

We did not locate *H. clathrata*. The habitat as detailed by David Pryce (pers. comm.) and in Wallace (2011) was, however, represented well at Bogach (Figure 3.32). The lochan was surrounded by a thick vegetation raft dominated by dense rush and sedge tussocks. There was birch scrub within this vegetation raft and the water table only occasionally formed shallow pools, as required by this species (Wallace, 2011). Although three methods of trapping were used, only the most stable areas of the vegetation raft could be surveyed

safely. Some areas of suitable habitat could not be accessed due to nesting ospreys. The site certainly remains suitable for this species.

3.2.4 Site condition evaluation

3.2.4.1 *Diptera*

The small size of the aspen woodland at Alvie SSSI means that inputs of dead wood are likely to remain low and inconsistent relative to larger sites such as Invertromie. It is possible the aspen hoverfly periodically becomes extinct from the site when there is a break in the continuity of suitable dead wood. The nearest site that consistently supports the species is within 2 km at Speybank (NH8306), and dispersing individuals could replenish the population at Alvie. Even though the habitat may be temporally inconsistent, it still has the ability to support a population temporarily. Individuals could then disperse back to Speybank and other neighbouring sites, acting as a buffer against other environmental changes in the wider area. The importance of Alvie SSSI for *H. ferruginea* is, therefore, its contribution at the metapopulation scale rather than as an individual site.

The site is subject to heavy grazing by sheep and deer within the woodland resulting in poor regeneration of aspen trees. During the survey very few aspen saplings were encountered and this lack of regeneration could further reduce the consistency of dead wood input over the long-term.

3.2.4.2 *Coleoptera*

There only appeared to be one area of suitable habitat for *D. aquatic*a (south-east bank of Loch Alvie). Other areas of loch shore were cobbled, which also renders them unsuitable. This makes the one area of suitable habitat extremely important, and renders it vulnerable to local extinction in the event of a disaster (such as a pollution event or disease). We therefore recommend management to maintain this area, and consideration to be given to creating new areas of habitat.

3.2.4.3 *Mollusca*

The mollusc results show that *V. lilljeborgi* is distributed through several habitat types around Loch Beag, and that it can be detected even with a fairly modest level of sampling. This implies that the species is relatively common and stable in suitable habitats.

Around Loch Beag, *V. lilljeborgi* inhabits the reed beds on the north margin and the grazing marsh along the west margin. We can reasonably infer that it inhabits the reed beds along the south margin. We found it in the mire between Loch Beag and Loch Alvie; hence it may also inhabit the reed fen around the west shore of Loch Alvie that was not sampled. It does not appear to exist on any mineral-dominated shores (beaches).

From our sampling, it seems that the highest densities are along the western margin of Loch Beag, in sedge tussock coves. The presence of juveniles demonstrates that breeding populations exist in multiple locations and habitat types, from mire to sedge marsh. The results obtained do not provide an accurate picture of the spatial distribution of *V. lilljeborgi* at this site, and further survey effort may locate the species in other areas.

3.2.4.4 *Trichoptera*

Although we did not find *H. clathrata*, the site continues to offer excellent habitat around Bogach lochan.

3.2.5 Site management recommendations

A number of new rare species from other taxa groups were found during our surveys. We therefore recommend that future SCM also target Araneae, Lepidoptera and Odonata. Speculative surveys could also be undertaken to ascertain the value of other invertebrate taxa. Recommendations for taxa detailed in site documentation are provided below.

3.2.5.1 *Diptera*

Efforts should be made to ensure that all dead wood is retained, as well as any old or diseased aspen trees, to allow continuity of habitat suitable for *H. ferruginea*. Up-rooted trees can be cut at the root-plate to ensure much of the tree is in contact with the ground to prevent drying out of decaying sap beneath the bark. Two such trees exist on site at NH864083 and NH862087. The natural regeneration of aspen woodland should be encouraged. This would require a reduction in grazing pressure by either fencing off areas for aspen regeneration or decreasing the number of animals.

3.2.5.2 *Coleoptera*

It is essential that the single area of habitat suitable for *D. aquatica* is maintained. We would strongly recommend creating new areas of suitable habitat to aid in their colonisation.

3.2.5.3 *Mollusca*

As we have no evidence to suggest that the status of *V. lilljeborgi* has changed, there are no grounds for advising a change in management practices. Its habitats seem reasonably secure, and it is recommended that management practices should remain the same, particularly with regard to maintaining water level regimes and grazing marsh character.

3.2.5.4 *Trichoptera*

The site continues to offer excellent habitat for *H. clathrata*, and so we would encourage management to maintain this. The species has not been found on site since 1967, however, so there is a possibility that it may have become locally extinct. We therefore recommend a targeted survey.

3.3 Ben Heasgarnich

3.3.1 Site description

Ben Heasgarnich SSSI is a montane area covering 4,048 ha. It is one of a series of arctic-alpine sites on calcareous schist in the Breadalbane range. This is one of the few upland sites where the altitudinal range of semi-natural habitats has remained intact, consequently the montane flora is diverse and representative. There is a range of habitats including alpine calcareous grasslands, cliff face, rocky outcrops, flushes, rock crevice communities, calcicolous snowed vegetation and late-lie snowed communities. The site supports a number of biological features, including lichen, bryophyte and vascular plant assemblages, alpine calcareous grassland, rocky slopes, as well as the sawfly feature considered as part of this study.

3.3.2 Summary of known invertebrate interests

The notified sawfly feature was surveyed.

Hymenoptera: Symphyta: *Pachynematus arcticus* RDB1
Pachynematus arcticus is a rare montane species apparently restricted to Scotland. The larvae feed on alpine cinquefoil (*Potentilla cranzii*) which is widespread but localised to

sparse basic grassland, rocky places and crevices in mountains. There exists very little ecological data regarding *P. arcticus* except that the adult flight period extends from June to July (Benson, 1952).

3.3.3 Methods

We surveyed Ben Heasgarnich on 9 June 2013. The main track heading up to the high ground of Ben Heasgarnich was walked in search of alpine cinquefoil (Figure 3.5). The food plant and other nectar sources were swept with a net. Unfortunately the weather was suboptimal with cool, moist fog clinging to much of the hill throughout the day (despite the weather forecast predicting clear skies and sunshine).

3.3.4 Results

No specimens of *P. arcticus* were found at Ben Heasgarnich.

3.3.5 Site condition evaluation

There is very little ecological data regarding *P. arcticus*, and this limits our ability to assess the condition of Ben Heasgarnich. The food plant, however, remains scattered across the site and therefore it is possible that *P. arcticus* persists. Alpine cinquefoil is a nationally scarce plant and occurs in alpine and subalpine calcareous grassland. This habitat type is a designated feature of Ben Heasgarnich and its condition in 2004 was assessed as 'unfavourable – no change'. Pressures from grazing deer and sheep, vehicles and muirburn on higher parts of the site are thought to be responsible for deterioration of montane vegetation. Given that *P. arcticus* is dependent on flora associated with this habitat type, it can be inferred that deterioration of this habitat could have a negative effect on its population.

3.3.6 Site management recommendations

We have no specific management recommendations to make. The persistence of the species at Ben Heasgarnich is, however, likely to be dependent on the condition of the montane calcareous grassland and management that enhances this feature will benefit this sawfly. Such management is already set out in the Site Management Statement prepared by SNH. Upon improving the habitat, a targeted survey is recommended.

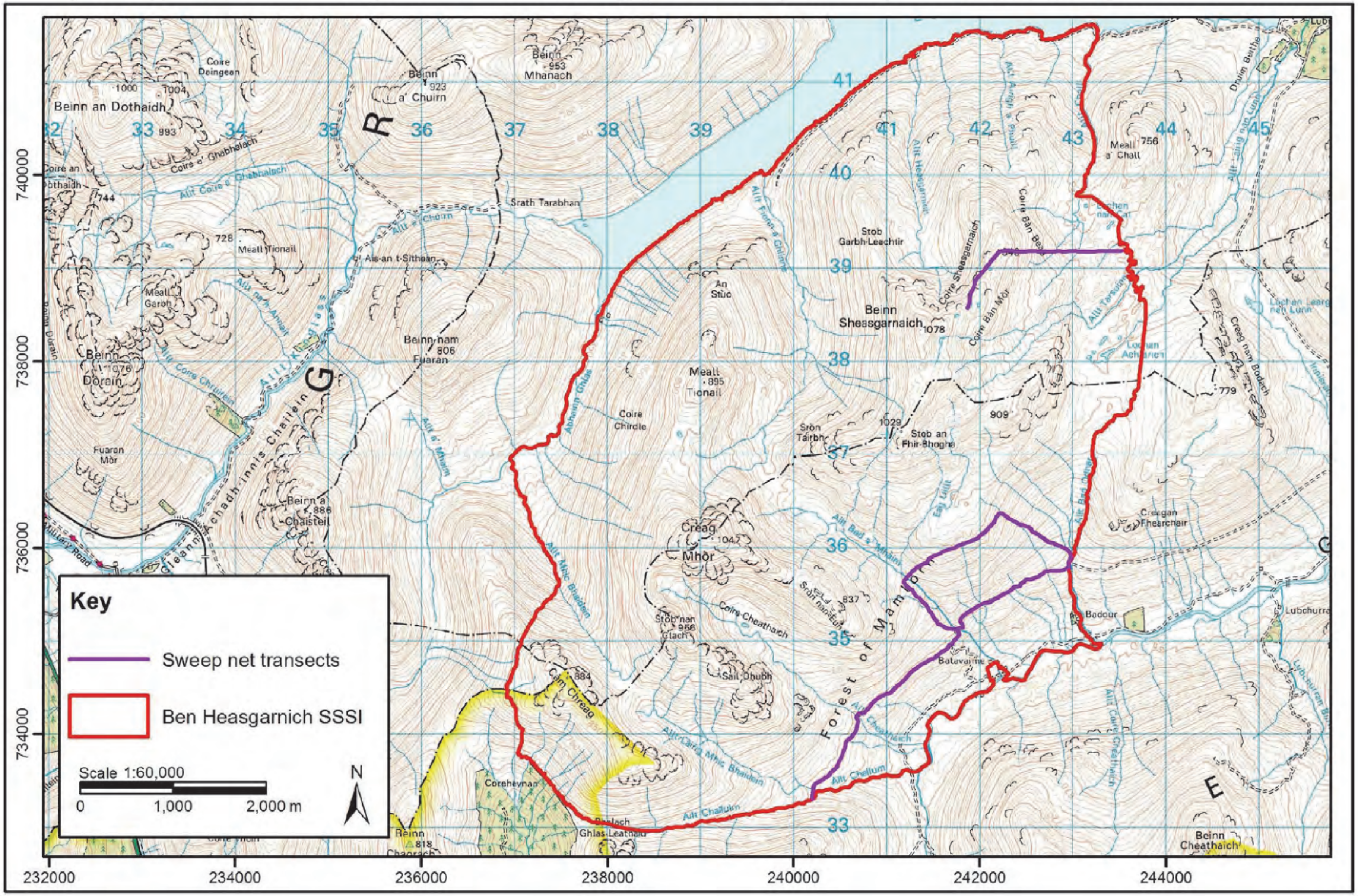

Figure 3.5. Survey route in Ben Heasgarnich SSSI

3.4 Ben Lomond

3.4.1 Site description

Ben Lomond SSSI covers an area of 2,374 ha on the east side of Loch Lomond immediately north of Rowardennan and at the heart of the Loch Lomond and Trossachs National Park. The site is at the south western edge of the Highlands and is the most southerly hill in Scotland. It exceeds 914 m in height. It is distinct from other hills in the Southern Highlands in that it retains remnants of the full range of upland plant communities from low to high elevation – a feature that has been lost from neighbouring hills. The upland assemblage of plant communities includes alpine flushes, alpine summit communities, subalpine willow scrub, subalpine dry dwarf shrub heath and blanket bog, representing vegetation typical of the south west Highlands.

The site has a number of biological features, including vascular plant assemblage, subalpine dry heath and snowed as well as the invertebrate assemblage considered here.

3.4.2 Summary of known invertebrate interests

The notified invertebrate assemblage feature was surveyed.

3.4.2.1 *Hymenoptera: Symphyta*

Nematus reticulatus RDB3
This sawfly is found within the arctic-alpine zone across the Scottish Highlands. The larvae feed on the leaves of blaeberry (*Vaccinium myrtillus*) at elevations above 600 m. The adult flight period lasts from May to June and they can often be swept from the larval food plant (Benson, 1958; Liston *et al.*, 2010). Other than the basic details included in Benson (1958) there is no published information about the ecology of *N. reticulatus*.

3.4.2.2 *Lepidoptera*

Erebia epiphron (mountain ringlet)
This montane butterfly is found in two areas of the UK, the hills of Cumbria and in the highlands of central Scotland. Adults generally emerge from late-June to early August and can be found on south-facing slopes between 400 and 800 m altitude. They tend to fly only in relatively calm, sunny conditions, waiting out cold, overcast days deep in tussocks of grass. Adults tend to be found close to flushes or damp depressions close to the larval food plant, mat grass (*Nardus stricta*), although other montane grasses may be used.

Boloria euphrosyne (pearl-bordered fritillary)
This fritillary is associated with sheltered woodland edges and open glades on south facing slopes with mosaic of bracken and violets (*Viola* spp.). The main larval food plant is the common dog violet (*V. riviniana*). On mild, sunny days in March and April, *B. euphrosyne* larvae emerge from overwinter to bask on warm, dead bracken fronds and other vegetation, and feed on the fresh growth of *Viola* spp*. s*eedlings. Later in the year, the fresh growth bracken provides a warm sheltered micro-climate for the developing *B. euphrosyne* larvae before they enter into hibernation.

Boloria euphrosyne can be on the wing from late-April in Dumfries and Galloway, although colonies in Argyll more typically emerge from mid to late May and can be found on the wing until mid-June. In Perthshire, adult *B. euphrosyne* have been recorded on the wing in late June and mid-July (Duncan Davidson, Butterfly Conservation, pers. comm.). There are very few records of *B. euphrosyne* from around Ben Lomond. Individual butterflies were recorded near the Glashlet Burn on Ben Lomond (NN3701) by the Ben Lomond Ranger service on 10 and 21 May 2000. A third *B. euphrosyne* was recorded from Ben Lomond at (NN359014) on

6 April 2004. It is unclear if this last record was of an adult butterfly or larva. The low number of records suggest that peak emergence of *B. euphrosyne* is likely to be later here than at milder coastal sites in Argyll and in Dumfries and Galloway.

Most sites with *B. euphrosyne* also tend to host its close relative, the small pearl-bordered fritillary (*B. selene*). This species is mainly associated with damper areas where its main larval food plant, marsh violet (*V. palustris*) grows. It tends to emerge around 10-14 days later than *B. euphrosyne* in Dumfries and Galloway and Argyll. Around Ben Lomond, the peak emergence of *B. selene* tends to be mid-June to early-July, and individuals can be recorded in early August.

In 2013, the long, cold spring had a significant effect on the emergence dates of most spring butterfly species, with orange-tips (*Anthocharis cardamines*) emerging around 2-3 weeks later than average, and green-veined whites (*Pieris napi*) first emerging 3-4 weeks later than average. Warm, sunny weather later in the spring and summer allowed many later-emerging butterfly species to 'catch-up', with their peak emergence dates closer to the yearly average (Butterfly Conservation, pers. comm.)

3.4.3 Methods

Fieldwork was completed in 2013 and 2014.

3.4.3.1 *Hymenoptera: Symphyta*

We surveyed Ben Lomond on 15 June 2013, walking the main track heading up to the summit of Ben Lomond and sweeping the food plant and other nectar sources (Figure 3.6). Unfortunately, the weather was suboptimal, with frequent rain and fog clinging to the mountain tops.

We made an additional visit on 22 June 2014, when conditions were bright and sunny, with temperatures reaching approximately 17°C. As the larvae of the target species is associated with blaeberry above 600 m elevation, the survey strategy involved walking the public path from Rowardennan Lodge (NS360995) to the summit of Ben Lomond (NN366028) and back down via Sron Aonaich (NS375004). Sampling took place along our route with a series of forays to sweep net the foliage of blaeberry and surrounding vegetation where adults might be present and this route took six hours to walk. The 2014 route is shown in Figure 3.7.

3.4.3.2 *Lepidoptera*

2013 records of *E. epiphron* were obtained from the Loch Lomond and Trossachs National Park ranger Fraser McKechnie, who recorded 14 individuals on 22 July in NN3602 between altitudes of 660 m and 780 m.

Ben Lomond was visited on 9, 10, 13 and 14 July 2013 and on 16 June 2014 during warm (up to 28 ^{o}C on 9 July) and calm conditions. Due to the late emergence of many spring butterfly species, the survey visits for *B. euphrosyne* were planned for mid to late June 2013. However, this was not possible due to unsuitable weather conditions, and so in addition to recording active butterflies during survey transects, sizeable patches of violets growing among bracken were examined for feeding damage by *B. euphrosyne* larvae on the steep, south-facing slopes. An additional visit was made during June 2014 when weather was suitable.

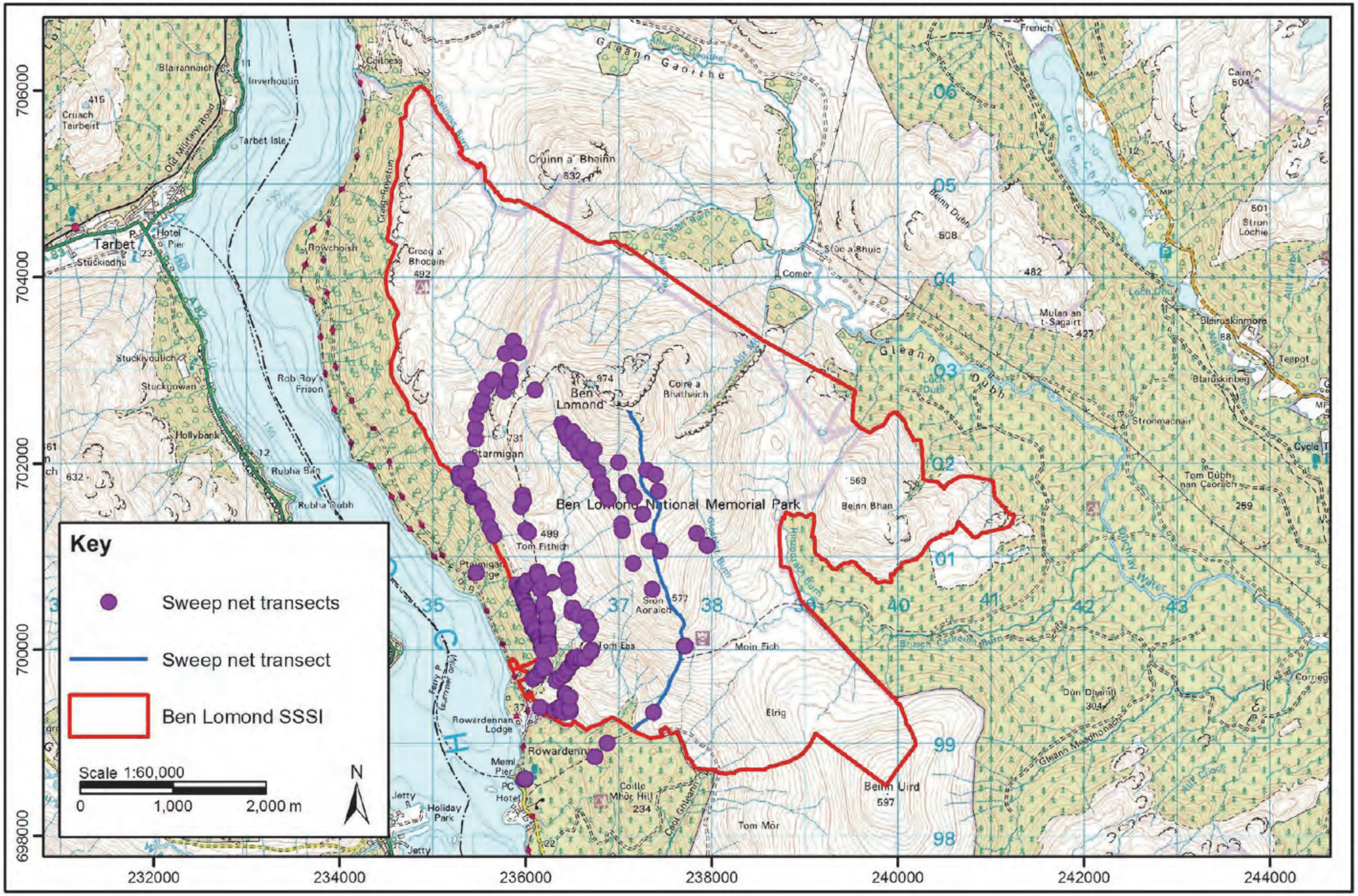

Figure 3.6. Survey locations in Ben Lomond SSSI in 2013 (line = Symphyta transect; points = Lepidoptera sample locations)

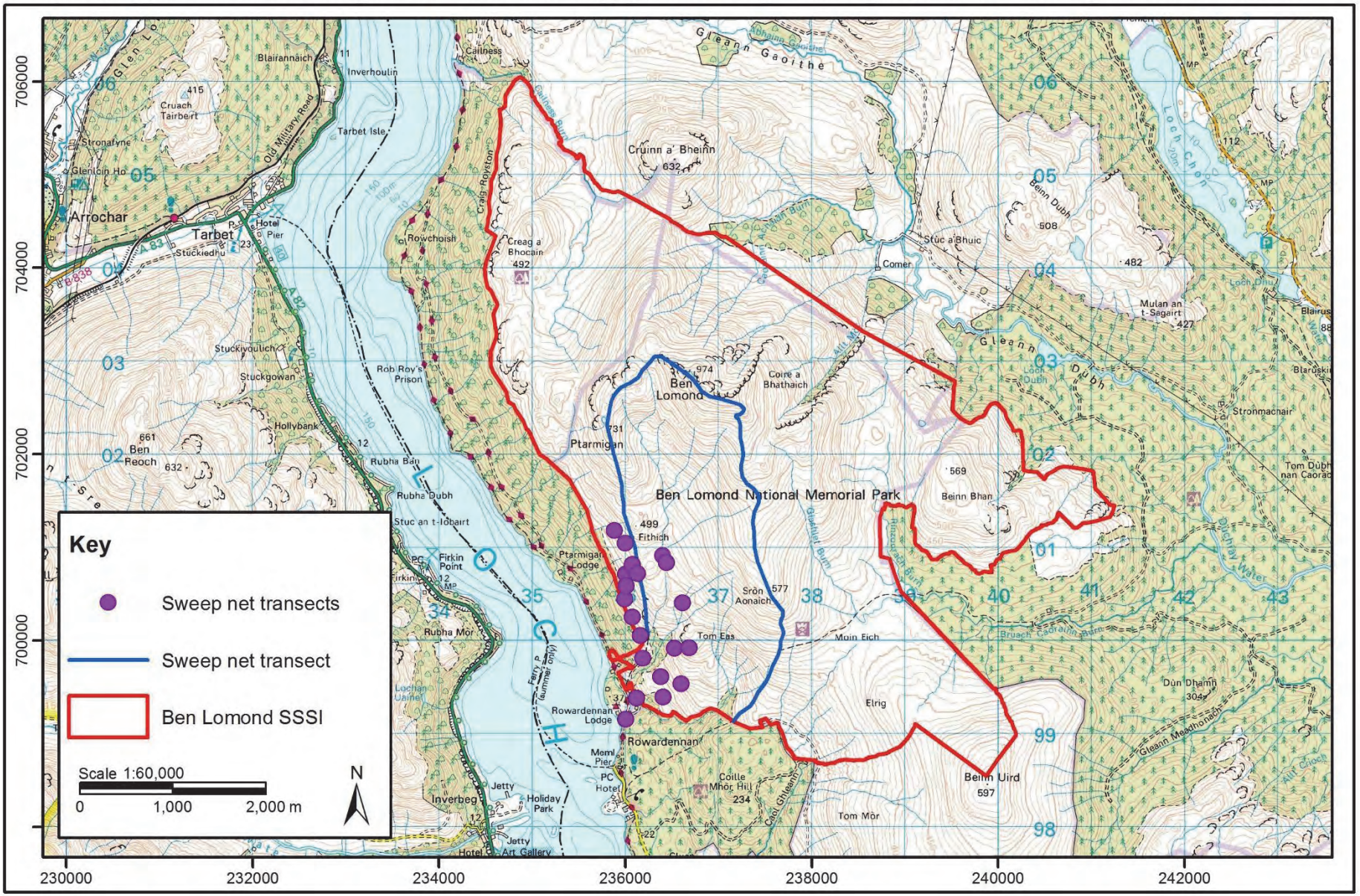

Figure 3.6. Survey locations in Ben Lomond SSSI in 2014 (line = Symphyta transect; points = Lepidoptera sample locations)

High altitude butterfly transects (up to 974 m) were carried out on 9, 13 and 14 July 2013 for *E. epiphron*, mainly focusing on the south-west facing slopes where the species is generally recorded. The north-west facing slopes (NN3502) were also surveyed in warm, calm, sunny conditions on 13 July, and the south-east facing slopes around the Glashlet Burn on 14 July 2013. The steep lower slopes of Ben Lomond with suitable bracken, violets and favoured nectar plants (*Cirsium palustre, Lychnis flos-cuculi* and *Ajuga reptans*) were also particularly targeted on 9, 10 and 13 July 2013 and 16 June 2014.

Survey locations from 2013 are shown in Figure 3.6, while those from 2014 are shown in Figure 3.7.

3.4.4 Results

3.4.4.1 *Hymenoptera: Symphyta*

Although no specimens of *N. reticulatus* were found during 2013, a single adult female *N. reticulatus* was found during the 2014 visit. This specimen was swept from blaeberry growing at an elevation of 700 m on the slopes of Ben Lomond on 22 June 2014 at NN358022. The food plant, blaeberry, is widely distributed above 600 m across Ben Lomond particularly on the slopes of Ptarmigan (Figure 3.33). However, there was evidence that this shrub has been suppressed in many areas by sheep grazing.

3.4.4.2 *Lepidoptera*

Ten adult *E. epiphron* were recorded on the south-west facing slopes on 9 July 2013 (within NN3602, NN3601 and NN3701) between altitudes of 572 m and 687 m, and a single adult was recorded on 14 July at 751 m (NN37300193). Examples of habitat are shown in Figures 3.34 and 3.35.

All *E. epiphron* recorded were flying across open hillside in warm, sunny conditions. One individual was observed to land and feed on tormentil, while others were moving across the slopes. The larval food plant was abundant and widespread across the surveyed area.

While *N. stricta* was recorded and conditions were warm and calm, *E. epiphron* was not observed on north-west facing slopes (NN3502) on 13 July 2013, suggesting that south-facing slopes are preferred. While surveying the north-facing slopes, the very local micro-moth *Udea uliginosalis* was recorded. This appears to be the most southerly record of this Scottish upland specialist. Other upland specialist species recorded were the local mountain grass moth *Crambus ericella* and the pretty pinion (*Perizoma blandiata*).

No adult *B. euphrosyne* were recorded. Habitat was, however, suitable, consisting of *V. riviniana* and *V. palustris* growing within patches of *P. aquilinum* on south-facing slopes (Figures 3.36 and 3.37). A range of nectar plants were also present, including marsh thistle (*Cirsium palustre*) and cross-leaved heath (*Erica tetralix*).

While surveying the lower slopes of Ben Lomond on 10 and 13 July 2013, *V. riviniana* plants with potential larval feeding-damage were observed at NS36429973, NS36449984, NN36150010 and NS35650133. No larvae were found, however, despite hand searching in the surrounding vegetation.

On all visits, the closely-related *B. selene* was observed to be abundant and widespread on the lower slopes. A total of 72 were recorded, many of which appeared freshly emerged. Another viola-feeding butterfly species, the dark-green fritillary (*Argynnis aglaja*) was also widely recorded on the south-west facing slopes on 10, 13 and 14 July 2013.

3.4.5 Site condition evaluation

3.4.5.1 *Hymenoptera: Symphyta*

Little ecological information is available for *N. reticulatus* and this limits our ability to assess the condition of Ben Lomond. However, at a basic level the presence of the food plant, blueberry, is necessary to support this species. Blaeberry is widespread on heath, moor and woodland, particularly in the north and western parts of Britain. During the current survey the continued presence of *N. reticulatus* was confirmed by a single specimen. The widespread presence of the food plant across Ben Lomond means it is probable the site supports a viable population. The Site Management Statement for Ben Lomond, prepared by SNH, states that many of the upland vegetation communities are in 'unfavourable condition' due to historical grazing pressure by sheep. Although not quantified, we noted that the amount of blaeberry on the higher ground of Ben Lomond was relatively sparse and is possibly suppressed by grazing. The degradation of this habitat over the years might have a negative effect on the population of *N. reticulatus*.

3.4.5.2 *Lepidoptera*

No *B. euphrosyne* were recorded during any of the visits to Ben Lomond. The survey was likely to be too late in the year to record adult *B. euphrosyne*, which probably peaked emergence around 14 days prior to the 2013 visit, while the 2014 should have been within this peak period. Nonetheless freshly emerged (bright and undamaged) *Boloria selene* were abundant on the lower slopes of Ben Lomond on each visit in 2013 and 2014. As suitable habitat was abundant and two other *Viola*-feeding fritillary species were present, the site appears to be in favourable condition for *B. euphrosyne*.

The site appears to be in favourable condition with respect to *E. epiphron*. The larval food was widespread and in good condition across the slopes. Although sheep were present and observed grazing at altitudes where adult *E. epiphron* were found, the level of grazing does not appear to be detrimental to the *E. epiphron* colony.

3.4.6 Site management recommendations

3.4.6.1 *Hymenoptera: Symphyta*

If current management is continued, it is likely that the site will be restored to favourable condition. We recommend, however, that the restoration of blaeberry is monitored, and management plans adjusted based on the results of this work.

3.4.6.2 *Lepidoptera*

The main threat to *B. euphrosyne* colonies is the loss of *Viola* spp. through over-shading by encroaching scrub or trees, or over-dense carpets of dead bracken. On shallow gradient slopes or flat sites where colonies are found, a thick layer of dead bracken can build up if no grazing is present, which can inhibit growth of *Viola* species. This is generally not a problem on the steep south-west facing slopes, where the main larval food plant of *B. euphrosyne* was abundant. *Viola palustris* was also widespread and locally abundant in damp flushes, shelves and out-cropping on the lower slopes.

The main threats to *E. epiphron* are over-grazing by sheep of the larval food plant, mat grass, and nectar plants such as heath bedstraw (*Galium saxatile*), meadow buttercup (*Ranunculus acris*) and tormentil. Sheep were present across the slopes of Ben Lomond, but the density seems to be at a suitable level. Existing management is likely to be sufficient to maintain this element of the feature.

3.5 Black Wood of Rannoch

3.5.1 Site description

Black Wood of Rannoch SSSI is located on the southern side of Loch Rannoch, and covers an area of 1,888 ha. It supports Caledonian forest habitat and is a remnant of the once extensive native pine and birch woods of Scotland. The site has the most extensive area of relict Caledonian forest in Perthshire and is an example of the genetically distinct central group of native pinewoods. The canopy mainly consists of native pine and birch, with ground flora communities typical of acid heath. The site supports a wide variety of biological features, including fungi and lichen assemblages, native pinewood, upland birch woodland, breeding birds, and dragonfly assemblage as well as the invertebrate assemblage considered as part of this study.

3.5.2 Summary of known invertebrate interests

Although Odonata are included within the invertebrate assemblage feature, SNH instructed that this group should not be included in this project. The species for which the other groups are included in the invertebrate assemblage feature are not defined in the citation or Site Management Statement. Supporting documents (Scottish Natural Heritage, 2003b). were used to target survey work, as described below.

3.5.2.1 *Araneae*

Four Red Data Book (RDB) species have been recorded at Black Wood of Rannoch: *C. subsultans, D. torva, H. soerenseni* and *Robertus scoticus*, all strictly associated with Caledonian pine forest (these are the only records of these species outside of Speyside), and *Robertus scoticus* (Scottish Robert) RDB1, a spider found amongst moss and pine litter, particularly in damp areas of Caledonian forest. Specimens have been found between June and October.

3.5.2.2 *Coleoptera*

Several species from a wide range of families contribute to this order being included in the invertebrate assemblage feature. Some are:

Mycetophatgus fulvicollis
Mycetophagus fulvicollis (Mycetophagidae) is a hairy fungus beetle living in decaying organic material. It was thought to be extinct until the latest record from 1970.

Abdera affinis RDB1
Abdera affinis (Melandryidae, false darkling beetle) is found amongst fungus on trees and old wood (Shirt, 1987). In the UK this species is only known from Strathspey in the Highlands and Black Wood of Rannoch in Perthshire.

Cryptocephalus decemmaculatus (Ten-spotted pot beetle) RDB2
Cryptocephalus decemmaculatus is a chrysomelid beetle associated with birch and willow. Adults are recorded between June and August on trees growing amongst sphagnum (Douglas, 2001). The common name is derived from the pot-shaped case made from leaf litter in which the eggs are deposited. The larvae live for a year in ants' nests before pupating (Shirt, 1987). It has been suggested that this species is under threat from deforestation of deciduous woodland via conifer plantation and clear-felling (Hyman & Parsons, 1992). Its distribution is disjunct in the UK, with individuals found in Black Wood of Rannoch in Perthshire, Muir of Dinnet in Grampian and Braemar in Aberdeenshire, with records from Staffordshire, Cheshire and East Sussex (Douglas, 2001).

3.5.2.3 *Hemiptera and Hymenoptera*

Although Hemiptera and Hymenoptera are included in the information provided by SNH (Table 1.1), there are no species highlighted in the citation or supporting documents (Scottish Natural Heritage, 2003b). The high quality woodland habitat has, however, excellent potential to support important communities of true bugs and Hymenoptera – for example wood ants. We, therefore, undertook speculative surveys for these groups.

3.5.2.4 *Lepidoptera*

Although Lepidoptera were included in the feature details provided by SNH (Table 1.1) there are no species named in the citation. The dossier for the site, however, names three rare Lepidoptera as being present: *Apotomis infida* (Rannoch marble), *Pammene luedersiana* (Inverness piercer) and *Synanthedon scoliaeformis* (Welsh clearwing).

Apotomis infida (Rannoch marble)
This rare micro-moth feeds on sallow (*Salix caprea*), and is on the wing between July and August. It was last recorded at the site in 1977 (Scottish Natural Heritage, 2003b).

Pammene luedersiana (Inverness piercer)
This rare micro-moth feeds on bog myrtle (*Myrica gale*) and bog bilberry (*Vaccinium uliginosum*), and is on the wing between July and August. It was last recorded at the site in 1919 (Scottish Natural Heritage, 2003b).

Synanthedon scoliaeformis (Welsh clearwing) RDB3
This species develops as a larva within old downy birch trees, feeding on the inner bark. The adult is on the wing between June and early-July. It is thought that the base of the tree must not be shaded or smothered by vegetation in order to provide a warmer micro-climate for the larvae. This is a species of more open woodland on wet acidic pasture or moorland, and it was last recorded at the site in 1995 (Scottish Natural Heritage, 2003b).

3.5.3 Methods

Fieldwork was completed in 2013.

3.5.3.1 *Terrestrial invertebrates*

Because of the diversity of invertebrate groups, a variety of sampling methods were required over the entire summer. The majority of Black Wood of Rannoch is Caledonian pine forest, with some conifer plantation and open pastoral moorland. All three of these habitats were surveyed.

One pitfall trap transect was set on open moorland and two in Caledonian pine forest. These traps targeted ground-dwelling invertebrates including Araneae, several Coleoptera families, some Hemiptera families and Formicidae. The pitfalls were set twice and collected on 18 June and 4 July.

There were two woodland habitats, birch plantation and Caledonian pine forest. Twenty bark traps were set across the site and collected on 25 and 26 July after two months. The bark traps were complemented by bark brushing, aimed at specialist arboreal species across several invertebrate orders living in bark crevices.

Searching, sweep net transects and bugvac sampling were employed at various locations in the woodland and open moorland to make sure all available habitats were surveyed. These sampling methods collect invertebrates across a variety of taxa from the litter layer and

herbaceous undergrowth. Active surveys were undertaken on 6, 17 and 18 June and 4 and 26 July. Sample locations are detailed in Table 3.7 and shown in Figure 3.8.

Table 3.7. Terrestrial invertebrate sample locations at Black Wood of Rannoch

Grid reference	Sampling method	Location description
NN5424456537	Bark trap	Birch Woodland
NN5387656639	Bark trap	Birch Woodland
NN5338856655	Bark trap	Birch Woodland
NN5290856737	Bark trap	Birch Woodland
NN5240057040	Bark trap	Birch Woodland
NN5622256128	Bark trap	Caledonian pine forest
NN5634055633	Bark trap	Caledonian pine forest
NN5693856023	Bark trap	Caledonian pine forest
NN5730555968	Bark trap	Caledonian pine forest
NN5777255797	Bark trap	Caledonian pine forest
NN5766655668	Bark trap	Caledonian pine forest
NN5809255585	Bark trap	Caledonian pine forest
NN5814255242	Bark trap	Caledonian pine forest
NN5816354996	Bark trap	Caledonian pine forest
NN5845955036	Bark trap	Caledonian pine forest
NN5897355632	Bark trap	Caledonian pine forest
NN5893855831	Bark trap	Caledonian pine forest
NN5886756193	Bark trap	Caledonian pine forest
NN5832256122	Bark trap	Caledonian pine forest
NN5787056129	Bark trap	Caledonian pine forest
NN5222855883	Pitfall trap	Grazed moorland
NN5432254961	Pitfall trap	Caledonian pine forest with high bracken abundance
NN5847755104	Pitfall trap	Caledonian pine forest
NN5266055158	Active search	Grazed Moorland
NN5416756719	Active search	Birch Woodland
NN5727955193	Active search	Conifer plantation
NN5762855864	Active search	Caledonian pine forest
NN5851955272	Active search	Caledonian pine forest
NN5632855441	Bark brushing	Caledonian pine forest
NN5696455997	Bark brushing	Caledonian pine forest
NN5782055672	Bark brushing	Caledonian pine forest
NN5786056118	Bark brushing	Caledonian pine forest
NN5809255585	Bark brushing	Caledonian pine forest

Grid reference	Sampling method	Location description
NN5222855883	Bugvac	Grazed Moorland
NN5432254961	Bugvac	Caledonian pine forest
NN5481755862	Bugvac	Heathland
NN5622256128	Bugvac	Caledonian pine forest
NN5730955934	Bugvac	Caledonian pine forest
NN5773955792	Bugvac	Caledonian pine forest
NN5813155250	Bugvac	Caledonian pine forest
NN5836256147	Bugvac	Caledonian pine forest
NN5847755104	Bugvac	Caledonian pine forest
NN5848155100	Bugvac	Caledonian pine forest
NN5695356003	Sweep net transects	Caledonian pine forest
NN5803156423	Sweep net transects	Caledonian pine forest
NN5850955062	Sweep net transects	Caledonian pine forest
NN5864055447	Sweep net transects	Caledonian pine forest

3.5.3.2 *Lepidoptera*

As both *A. infida* and *P. luedersiana* come to light (Sterling & Parsons, 2012), a heath trap was left overnight on 26 July (Table 3.8 and Figure 3.8). We set the trap at the transition between Caledonian pine forest and pastoral moorland in order to maximise the diversity of species to be captured. Trapped moths were photographed and released. Clearwing moths and butterflies were recorded whilst carrying out other surveys.

Table 3.8. Lepidoptera sample locations at Black Wood of Rannoch

Grid reference	Sampling method	Location description
NN5338454475	8V Heath trap	Bank of stream between Caledonian pine forest and open moorland

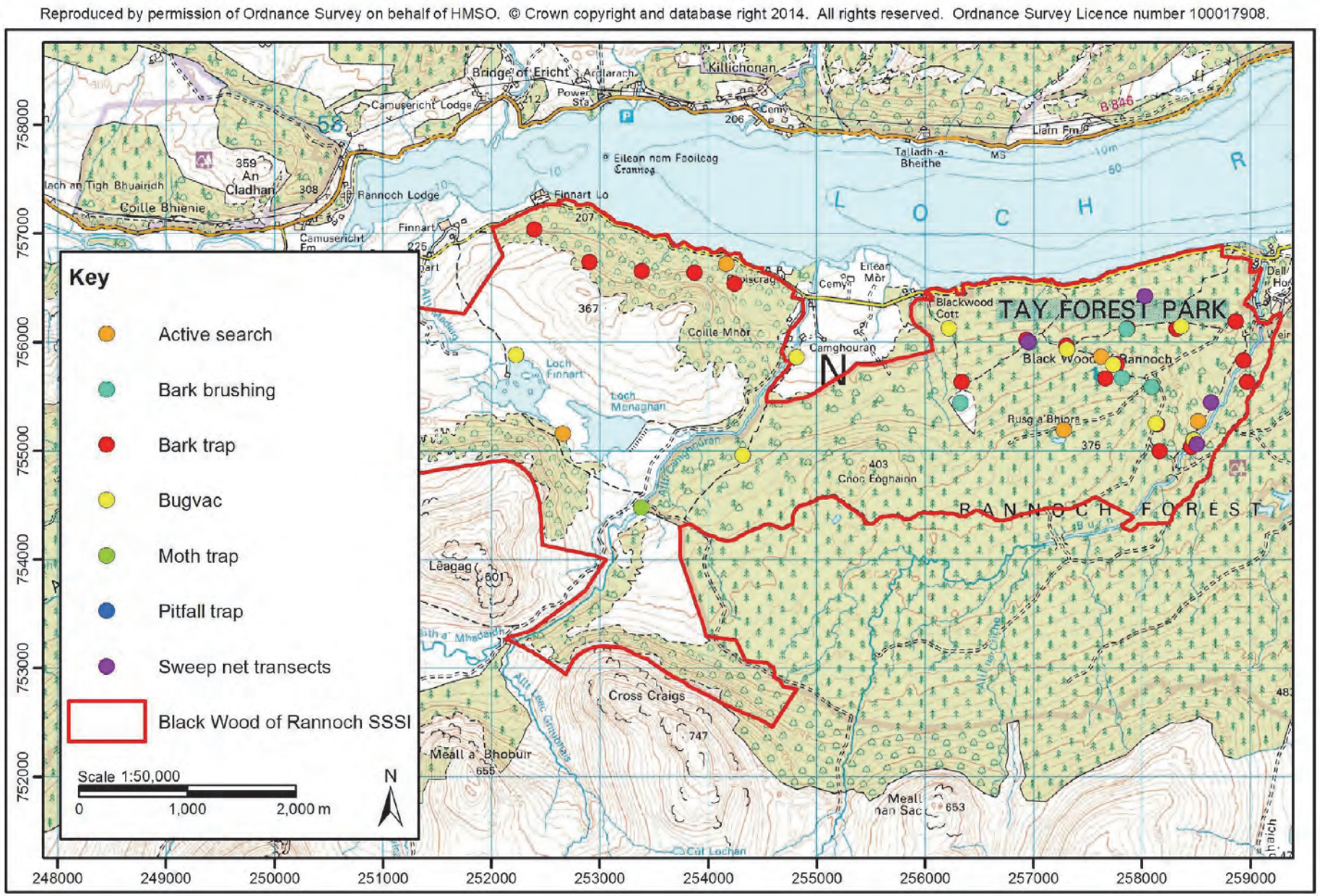

Figure 3.8. Survey locations in Black Wood of Rannoch SSSI

3.5.4 Results

3.5.4.1 *Terrestrial invertebrates*

Spiders and beetles were the most speciose groups collected, with 59 species and 33 species recorded respectively. The wood ant *F. lugubris* was found throughout the Caledonian forest.

Of the species included in the citation and supporting documents, only *C. subsultans* was found, a single male under a bark trap at NN570555968 on 26 July. We also found another nationally scarce species: *Philodromus margaritatus* (the lichen running spider). A single female, having constructed an egg sac beneath a bark trap, was found on 27 July on a Scots pine at NN5879355632, where bracken was largely absent from the understory. This is typical habitat for this species (Figure 3.38).

Four specimens of the nationally scarce ground beetle *Trechus rubens* were found at NN587755104 on 4 July, NN5432254961 on 14 July, NN5813155250 on 26 July (bugvac) and NN5432254961 on 18 June (pitfall traps). *Trechus rubens* is a northerly species associated with moorland moss and woodland litter (in which we collected our specimens).

We also found *Megasternum concinnum* (a hydrophilid beetle). This beetle is found in decaying grass and herbivore dung during the summer, and overwinters under stones and logs (Duff, 2008). We found one specimen on 18 June at NN5432254961 and two specimens on 4 July at NN5847755104, all from pitfall traps.

Although no other species listed (Scottish Natural Heritage, 2003b) were found, habitat remains suitable, and the exceptional quality of this site is demonstrated by the number of species recorded during our relatively limited surveys. We observed many examples of decaying deadwood, living trees with rotting sections and fungi that could support other rare beetles. It should, however, be noted that bracken is spreading through the site, and now dominates large areas of the woodland understory (Figure 3.39). All of the rare spiders found during this survey were located within the same small area of high quality woodland without bracken encroachment. The bracken will certainly be limiting habitat for a number of species, including *R. scoticus*. The open habitats surrounding the site were not found to support important invertebrate communities, although they are undoubtedly important for the hydrology of ponds supporting the Odonata feature.

3.5.4.2 *Lepidoptera*

Only 14 species of Lepidoptera were recorded, all common. The conditions on the night of the survey were damper than forecast, which may have limited moth activity. We had considerable difficulty in finding an evening between June and July with suitable weather for moth trapping. On several occasions we were forced to abort scheduled fieldwork after arriving on site to find torrential rain or high winds on days where the forecast was favourable.

While habitat is potentially suitable for *P. luedersiana*, we did not encounter the specific food plants. As this micro-moth has not been recorded on site since 1919, it may be considered extinct.

Although *S. scoliaeformis* was not found during our surveys, it is possible that it still persists on site. Bracken is, however, smothering the bases of much of the trees in potentially suitable open birch woodland which fringe the more open environment. This is certainly limiting suitable habitat for this moth.

3.5.5 Site condition evaluation

3.5.5.1 *Araneae*

The 59 species of spider found indicate the value of the woodland habitat in particular. Although we did not find *D. torva*, we recorded many *F. lugubris,* so prey items are available for this species. It should be noted that the two rare spiders found were located in an excellent area of forest, with no bracken in the ground layer. We did not find these species in areas with bracken encroachment, which is restricting available habitat for *H. soerenseni* and *R. scoticus*. If bracken is left to spread through the site, it is likely that these species will become locally extinct. Dense commercial plantation on site and adjacent to Black Wood of Rannoch cannot support the important spider species, and will therefore limit the ability of populations to colonise new areas. Furthermore, non-native conifers often establish within semi-natural habitats and can out-compete native species. Pockets of the forest, however, remain in excellent condition and support a diverse spider fauna.

3.5.5.2 *Coleoptera*

The 33 species of Coleoptera indicate the woodland offers a high quality habitat for beetles, and it is likely other species of conservation importance will be present. There was a large variety of deadwood habitat that supports saproxylic Coleoptera. The site also has birch and willow, which are the food plants of *C. decemmaculatus*. The encroachment of bracken is, however, limiting available habitat for species that live in the understory vegetation or rely upon more open areas.

3.5.5.3 *Hemiptera*

The high quality habitat is likely to support important Hemiptera communities. We recommend these are included in future surveys.

3.5.5.4 *Hymenoptera*

The woodland has the potential to support a variety of *Formica* spp. and other Hymenoptera communities, and targeted surveys should be completed to map nests throughout the site.

3.5.5.5 *Lepidoptera*

We recommend that a survey is undertaken to map food plants for *P. luedersiana,* and effort is made to ascertain its presence. Due to the encroaching bracken in pastoral habitats, smothering the bases of birch, there is a risk that the site will become unsuitable for this species.

3.5.6 Site management recommendations

In general, the encroachment of bracken must be controlled with urgency. This has already smothered much of the birch fringing the pastoral areas, rendering this habitat largely unsuitable for supporting *S. scoliaeformis*. Elsewhere, the bracken is continuing to encroach within the Caledonian forest, causing habitat loss for spiders, beetles and other taxa which live in the understory vegetation or ground litter layer. We therefore recommend that a survey is undertaken to map the bracken, and a management plan developed.

In addition, any encroachment from non-native conifers associated with the areas of commercial plantation must be monitored and controlled. Ideally, any commercial plantation within the site should be removed and replanted with species of local provenance. If possible, commercial plantation adjacent to the site should also be managed in this way.

3.5.6.1 *Araneae*

While we have confirmed that wood ants are present, we recommend that a survey is undertaken to map the extent of the resource. Surveys have shown that spider nest boxes are effective at detecting female *C. subsultans*. We would recommend this method is employed for future SCM, in combination with bark traps to increase the likelihood of collecting male specimens also.

3.5.6.2 *Coleoptera*

As well as controlling bracken, it is recommended that a management plan is developed in order to enhance the deadwood resource, following best practice guidance (Buglife, 2011). Examples from the excellent management by RSPB at Abernethy Forest may be employed at Black Wood of Rannoch (Cathrine & Amphlett, 2011).

3.5.6.3 *Hemiptera*

We recommend that a speculative survey should be considered to ascertain whether the site is important for this group.

3.5.6.4 *Hymenoptera*

We recommend that a survey is undertaken to map *Formica* spp. nests so as to inform future management of the site. These ants are important for the continued presence of the spider *D. torva*.

3.6 Cadder Wilderness

3.6.1 Site description

Cadder Wilderness SSSI covers an area of 40 ha and consists of mixed broadleaved woodland. The woodland, which has developed from an old, partly coppiced plantation is now dominated by a closed canopy of oak and birch and is one of the best examples of this habitat within East or West Dumbartonshire. The diverse range of habitats within the woodland, including local areas of marsh and grass field layers in more open areas, hosts a rich invertebrate assemblage.

3.6.2 Summary of known invertebrate interests

The notified invertebrate assemblage feature was surveyed.

3.6.2.1 *Coleoptera*

Cryptophagus corticinus
This is a silken fungus beetle that lives in decaying plant material or rotting wood and is associated with fungi found under the bark of decaying trees. In Finland, this species has been found to be strongly associated with forest fires, with populations peaking during the two years following such an event (Muona & Rutanen, 1994)

3.6.2.2 *Hymenoptera: Symphyta*

Arge enodis RDB1
Arge enodis has a widespread but localised distribution in the UK. The larvae feed on *Salix* spp. leaves, and the adult flight period extends from May to June (Benson, 1958). Very few additional ecological data exist, however, regarding this species.

Pseudohemitaxonus sharpi
The larvae are reported to feed on ferns (Polypodiaceae) and the adult flight period extends from May to June (Benson, 1958). Few additional ecological data are available for this species. *Strongylogaster continua* has been found to be a misidentification of *P. sharpi* (Liston & Sheppard, 2010).

3.6.3 Methods

Fieldwork was completed in 2013.

3.6.3.1 *Terrestrial invertebrates*

As *C. corticinus* is predominantly arboreal, we used 20 bark traps set on trees that were dead or had rotting sections. Traps were spread throughout the site (Table 3.9, Figure 3.9) and were in operation from 1 May to 3 June.

Table 3.9. Terrestrial invertebrate sample locations at Cadder Wilderness

Grid reference	Sampling method	Location description
NS5931871600	Bark trap	Deciduous woodland
NS5951771781	Bark trap	Deciduous woodland
NS5953871689	Bark trap	Deciduous woodland
NS5965671846	Bark trap	Deciduous woodland
NS5969371740	Bark trap	Deciduous woodland
NS5979171957	Bark trap	Deciduous woodland
NS6003971968	Bark trap	Deciduous woodland
NS6019672115	Bark trap	Deciduous woodland
NS6022672039	Bark trap	Deciduous woodland
NS5925971757	Bark trap	Deciduous woodland
NS5951471859	Bark trap	Deciduous woodland
NS5966471916	Bark trap	Deciduous woodland
NS5983071897	Bark trap	Deciduous woodland
NS5986971799	Bark trap	Deciduous woodland
NS6007971883	Bark trap	Deciduous woodland
NS6002072046	Bark trap	Deciduous woodland
NS6013772090	Bark trap	Deciduous woodland
NS6017472009	Bark trap	Deciduous woodland
NS6020271946	Bark trap	Deciduous woodland
NS6028371986	Bark trap	Deciduous woodland

3.6.3.2 *Hymenoptera: Symphyta*

We surveyed Cadder Wilderness on 6 June. The woodland edge and tracks through the wooded area were walked (Figure 3.9) and all food plants and nectar sources encountered were swept with a net. Adult sawflies were extracted and placed into tubes. Weather conditions were optimal with bright, warm sunshine throughout the day. Willow leaves exhibiting galls and curls associated with sawfly larval feeding were brought back to the laboratory for adult rearing, although this was unsuccessful.

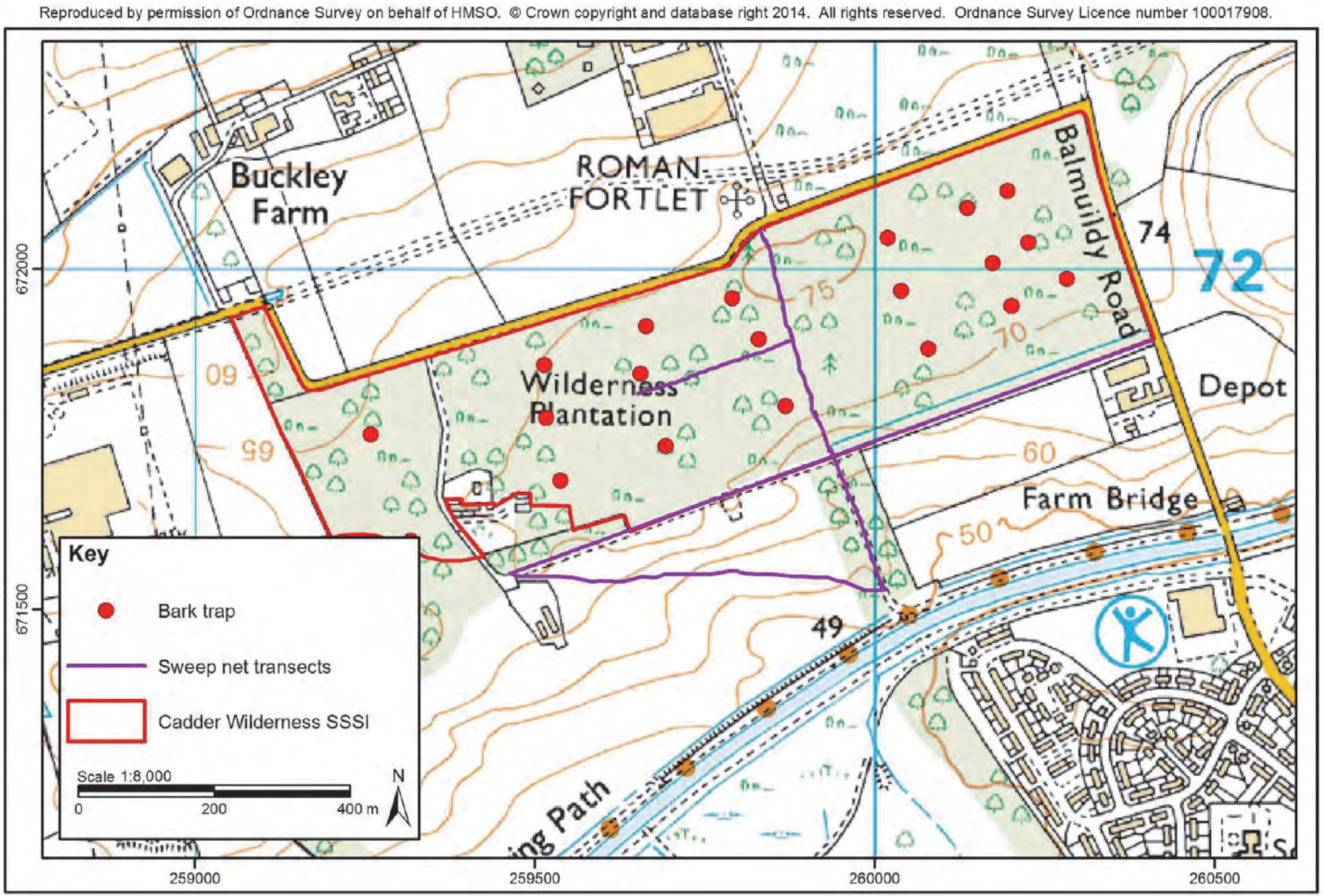

Figure 3.9. Survey locations in Cadder Wilderness SSSI

3.6.4 Results

Although we set a high concentration of bark traps throughout Cadder Wilderness, *C. cortincinus* was not found. There were obvious human impacts on the site, including fly-tipping and antisocial use. The habitat is, however, still favourable, with large amounts of dead wood of a variety of ages, both standing and fallen, and a good age structure amongst the living trees (Figure 3.40). This species may be most easily detected after a forest fire.

We found no specimens of *A. enodis* or *P. sharpi.* However, their larval food plants were present across the site (Figures 3.41 and 3.42). It is, therefore, possible that both sawflies still occur at the site.

3.6.5 Site condition evaluation

We did find the nationally scarce hoverfly *Anasimyia lunulata* (bog duck-hoverfly) while sweep netting NS598717 on 6 June. We recommend Diptera is considered in future SCM of the invertebrate assemblage.

A large number of sawflies specimens were collected during the visit. The failure to collect *A. enodis* and *P. sharpi* was perhaps due to local population dynamics.

3.6.6 Site management recommendations

We recommend that future SCM takes place after a fire in order to maximise the likelihood of detecting *C. cortincinus*. We also suggest that a programme of managed fires is considered, in order to encourage a healthy population of *C. cortincinus.*

Given the limited ecological information available regarding *A. enodis* and *P. sharpi* we have no specific management recommendations, except to conserve the existing expanse of *Salix* spp. and ferns at Cadder Wilderness. We also recommend research should be undertaken into the ecology of these species in order to better inform management on this and other sites.

3.7 Cairngorms

3.7.1 Site description

Cairngorms SSSI ranges in elevation from 200 to 1,309 m and covers an area of 29,162 ha that includes a large part of the Cairngorms massif, the most important mountain area in Britain for nature conservation. The Cairngorms include the greatest area of high land in Britain, and has an arctic-like character. A wide range of animal and plant species occur here, many of which are scarce nationally.

The site supports a range of montane and sub-montane plant communities, including native Scots pine woodland, a variety of mires, grasslands, heathlands, lochs and streams. The Caledonian forest on the lower slopes of the Cairngorms is part of a once continuous tract of native pinewood that once covered much of central Scotland. Acidic granite bedrock and glacial drift covers much of the site, supporting mainly acid tolerant plant species. Calcareous schist outcrop on the eastern and western flanks of the range support base-loving plants in some cliffs, screes and grasslands. There is a massive summit plateau, broad catchments anda considerable land mass above 1,100 m, which gives rise to areas with prolonged snow cover in a variety of situations supporting a greater range and extent of snow-influenced vegetation than in any other mountain system in Britain.

The site supports a wide variety of biological features, including fungi, lichen, bryophyte and vascular plant assemblages, native pinewood, dotterel (*Charadrius morinellus*), golden eagle

(*Aquila chrysaetos*), ptarmigan (*Lagopus muta*), snow bunting (*Plectrophenax nivalis*) as well as the invertebrate assemblage.

3.7.2 Summary of known invertebrate interests

The notified invertebrate assemblage feature was surveyed. The species for which groups are included in the invertebrate assemblage feature are not defined in the citation or Site Management Statement. Supporting documents (Scottish Natural Heritage, 2003c) were used to target survey work.

3.7.2.1 *Araneae*

The unique habitats offered by the plateau of the Cairngorms SSSI harbours a spider fauna found almost nowhere else but the Scottish Highlands, all occurring on elevations over 500 m. Although the inaccessibility of these areas and cryptic ecology may have resulted in under-recording of several montane species, the UK has very little habitat above 800 m and may support as yet undiscovered invertebrates. This should be considered exceptionally valuable. Besides *D. torva* and *P. elongata,* the other spiders of interest are:

Lepthyphantes antroniensis (Cairngorm ground-weaver) RDB1
In Scotland this species appears to be a montane specialist, found under stones and in low vegetation above 900 m elevation. However, on the continent it occurs in spruce and pine forests, as well as birch woods, although the microhabitat is very similar to those where it is found in Scotland. In the UK, this species is only known from the Cairngorms, where it has been recorded from the Lairig Ghru (in 1979 and 1980) and from Sròn a' Cha-no (in 1980) (Harvey *et al.*, 2002). It is possible that this spider may now be extinct in the Cairngorms. This is the only species of spider named in either the citation or Site Management Statement.

Arctosa alpigena (Alpine bear-spider) RDB3
An alpine specialist, this spider is found on mountains over 1000 m in dense mountain vegetation like mat. *Arctosa alpigena* hunts beneath the vegetation layer, protected from the exposed montane conditions. Adults are found between July and August.

Entelecara errata (wandering perfect-head) NS
Entelecara errata is a widespread linyphiid found on higher ground in North Wales, northern England and Scotland. The adults are found under stones from May to July.

Tiso aestivus (mountain tiso) NS
Adults are found under stones on mountains over 600 m from May to August. All recent records have come from Scotland where it is widespread, although damage to its preferred habitat by recreational use may be a threat.

Erigone tirolensis (Scottish money-spider) NS
Like *T. aestivus*, *E. tirolensis* is found under stones in montane situations, often higher than 900 m. In the far north where the climate is suitable, it may be found as low as 300 m. Restricted to the Scottish Highlands, adults are found from May to September.

Halorates holmgreni (Holmgren's mountain-spider) NS
Another montane linyphiid found as adults solely in the Scottish Highlands between May and September. *Halorates holmgreni* is found amongst stunted vegetation and under stones, usually above 900 m.

Mecynargus paetulus (Scottish mountain-spider) RDB2

Mecynargus paetulus is a mountain specialist living amongst stones and mat grass on snowfields above 850 m. Adults have been found from May to September. It is possible that this spider is under-recorded due to its inaccessible habitat.

Meioneta nigripes (black-legged weblet) NS
A montane linyphiid usually found on mountains over 500 m in north-west Scotland and North Wales. It is found between May and August under any cover available, primarily moss, mat vegetation and stones.

3.7.2.2 *Coleoptera*

A very diverse range of beetles inhabit the Cairngorms including several RDB species. As for the spiders, the unique montane habitats are likely to support rare beetles not found elsewhere in the UK. Besides *A. tristis*, some of the rarer species are:

Eudectus whitei NS
This rove beetle is found under stones and in moss on mountain summits. As well as Scotland, it has been found in the Yorkshire Dales where it is now considered to possibly be extinct. *E. whitei* has not been found outside of the UK, but it is considered unlikely to be endemic, as this group of beetles is poorly studied and so likely to be under-recorded (Backshall *et al.* 2001). This is the only beetle species named in either the citation or Site Management Statement.

Ostoma ferrugineum RDB1
Only found in relict Caledonian pine forest in Guisachan and Mar, this wood-boring species feeds on the heartwood and sapwood of Scots pines rotted by the fungus *Phaeolus schweinitzii*. Larvae can be collected in May and April and adults are found at the same time under pine bark. *Ostoma ferrugineum* appears to have poor powers of dispersal and requires Scots pine that has been left long enough for the associated fungus to colonise (Shirt, 1987).

Anastrangalia sanguinolenta (blood-red longhorn beetle) RDB3
A longhorn beetle found in coniferous woodland and on small pines in quaking peat bogs in the Scottish Highlands. Adults are particularly fond of umbellifers as a food source during summer.

3.7.2.3 *Hemiptera*

Three nationally scarce species of Hemiptera restricted to montane habitats are found in the Cairngorms.

Zygimus nigriceps NS
This true bug in the family Miridae is considered to be a boreal species and feeds on juniper, although older records suggest Scots pine as a food plant (Southwood & Leston, 1959). There are only a scattering of records from northern England and Scotland, and it is also uncommon where it occurs on the continent.

Eremocoris abietus NS
A ground bug confined to Scotland and associated with juniper, scots pine, crowberry (*Empetrum nigrum*) and bearberry (*Arctostaphylos* spp.). Recent records are restricted to the Highlands and it may occur at considerable altitudes where the associated plants are present.

Dicranotropis divergens NS

A plant hopper restricted to the Scottish Highlands where it lives amongst wet upland grassland at high altitudes.

3.7.2.4 *Hymenoptera*

Rare Hymenopterans in the Cairngorms are dominated by *F. exsecta* and *F. aquilonia*, found in open Caledonian pine forest. *Osmia uncinata* is also present, restricted to sunny rides with Caledonian pine forest with the food-plant bird's foot trefoil present.

Formica aquilonia (Scottish wood ant) NS
The Scottish wood ant can tolerate denser stands of continuous forest than *F. exsecta*, and nests are more often found on south-facing slopes. The nest mounds of *F. aquilonia* are large and the ants are able to manage the temperature within using their metabolic heat.

3.7.2.5 *Lepidoptera*

Most of the Lepidoptera listed on the SNH dossier are micro-moths, of which little is known. Of the macro-moths, *P. sobrina* is present as well as these high altitude specialists:

Anarta melanopa (broad-bordered white underwing) RDB3
This moth is on the wing between mid-May and June. The larvae feed on a number of montane plants, including alpine bearberry (*Arctostaphylos alpina*), blaeberry, cowberry (*Vaccinium vitis-idaea*) and crowberry.

Macaria carbonaria (netted mountain moth) RDB2
This species is on the wing between April and June. On windy days it makes short hops near the vegetation. The larval food plant is alpine bearberry.

3.7.2.6 *Mollusca*

Molluscs are not formally included in the citation, but were included in the invertebrate assemblage summary issued for this site as part of the tendering process (Table 1.1). *Vertigo geyeri* (Geyer's whorl snail), is currently unrecorded in the Cairngorms, but it could be present in calcareous flushes. Likewise, *Vertigo alpestris* (mountain whorl snail), could be present in rocky calcareous areas, particularly at higher altitudes. The only whorl snail confirmed from Cairngorms is *Vertigo modesta,* known only from Coire Garbhlach in Glen Feshie. We were, however, asked by SNH not to survey at this site as it is sensitive and had been surveyed recently (S. Scoggins, pers. comm.).

3.7.2.7 *Odonata*

There is no mention of Odonata in the SSSI citation even though two breeding sites were identified in Smith & Smith (1996); no previous *Coenagrion hastulatum* survey has been undertaken.

3.7.3 Methods

Fieldwork was completed in 2013 and 2014.

3.7.3.1 *Terrestrial invertebrates*

Due to the size of the area, survey locations were selected from three habitats to attempt to capture the greatest diversity within the limitations of this study: the Cairngorm plateau, Loch Eaniach and Glen Feshie. At each location, we used a variety of traps to ensure a wide range of taxa were collected. All terrestrial invertebrate fieldwork was completed in 2013.

The Cairngorm Plateau includes the largest area of high land in the UK, providing the only suitable habitat in the country for several montane specialists. The plateau habitats surveyed included snow fields and boulder fields where we used a combination of pitfall traps, bugvac sampling and direct searches on 16-17, 30-31 July, and 14-15 August. Two pitfall transects were set: one on Stob Coire an t-Sneachda, south-west of Cairn Gorm, and one on the summit of Ben Macdui. The snow field ground flora consisted of very shallow root montane plants and moss that offered shelter to most species of invertebrates. The habitat on the summit of Ben Macdui has very little vegetation, comprising mainly boulders with small gravel patches. Pitfall traps were used here to collect nocturnal ground dwelling species. This was also the first time bugvac sampling was used on the plateau, and its integration with active searching provided a well-rounded approach to collecting species that take cover in moss or under gravel, and would normally be very difficult to collect.

Loch Eaniach is a ribbon lake at the head of Gleann Eaniach surrounded by valley walls over 500 m high. The habitat around the lake consists of scree slopes, blanket bog, wet heathland and a small vegetation strandline surrounding the northern bank of the loch. Sampling methods for the area included bugvac and pitfall traps. Two transects of pitfall traps were set on 31 July and collected on 15 August. A transect was set on wet heathland where vegetation was dominated by heather (*Erica* spp*.* and *Calluna vulgaris*) and another on bog (*Sphagnum* spp., *Eriophorum* spp.) ensuring that a range of species was captured. Bugvac sampling took place in wet heathland and bog, as well as the vegetation strandline and loch-side vegetation.

Glen Feshie is another glaciated valley, 250 m lower in elevation than Loch Eaniach, yet another microclimate of the Cairngorms. The valley floor is dominated by ericoid shrubs but is much more florally diverse. The presence of trees was the greatest difference between this site and the previous two. Woodland within Glen Feshie varies from coniferous plantation, Caledonian pine forest (both dense and open) and birch woodland. Bark traps, pitfall traps and sweep net transects were used. We placed the latter in two habitats: birch woodland growing on very thin soiled scree slopes, and large Scots pine trees in open pine woodland. Twenty bark traps were set on 16 and 17 July, left for a month and collected on 15 August. Two pitfall trap transects were placed in thick and open Caledonian pine woodland and collected after two weeks on 31 July. Sweep net transects were carried out along the valley floor as they changed further up and included heathland, grassland and bankside vegetation of the River Feshie. We completed sweep net transects on 16 and 17 July. Survey locations are detailed in Table 3.10 and shown in Figures 3.10, 3.11 and 3.12. Planned moth surveys by heath trap were not possible due to weather conditions.

Table 3.10. Terrestrial invertebrate sample locations at Cairngorms

Site	Grid reference	Sampling method	Location description
Glen Feshie	NN8517191059	Bark trap	Silver birch on scree slope
Glen Feshie	NN8513791105	Bark trap	Silver birch on scree slope
Glen Feshie	NN8512891137	Bark trap	Silver birch on scree slope
Glen Feshie	NN8510991212	Bark trap	Silver birch on scree slope
Glen Feshie	NN8509091245	Bark trap	Silver birch on scree slope
Glen Feshie	NN8501491353	Bark trap	Silver birch on scree slope
Glen Feshie	NN8497991437	Bark trap	Silver birch on scree slope
Glen Feshie	NN8485091603	Bark trap	Silver birch overhanging river
Glen Feshie	NN8473192009	Bark trap	Open Caledonian pine forest with juniper understory

Site	Grid reference	Sampling method	Location description
Glen Feshie	NN8458492302	Bark trap	Open Caledonian pine forest with heather understory
Glen Feshie	NN8470392016	Pitfall Trap	Open Caledonian pine forest with heather understory
Glen Feshie	NN8492894837	Pitfall Trap	Caledonian pine forest
Glen Feshie	NN8459093346	Sweep net	Caledonian pine forest
Glen Feshie	NN8459792314	Sweep net	Open Caledonian pine forest with juniper understory
Glen Feshie	NN8469191334	Sweep net	Grassland
Glen Feshie	NN8469692011	Sweep net	Open Caledonian pine forest with heather understory
Glen Feshie	NN8499994392	Sweep net	Caledonian pine forest
Loch Eaniach	NN9166199900	Bugvac	Short lakeside vegetation
Loch Eaniach	NN9166399843	Bugvac	Heather moorland
Loch Eaniach	NN9164499924	Pitfall Trap	Heather moorland
Loch Eaniach	NN9166699922	Pitfall Trap	Wet heathland
Cairngorm Plateau	NH9962202829	Active search	Snow-field with thin vegetation layer of alpine mosses and plants
Cairngorm Plateau	NJ0052204057	Active search	South east slope of Cairn Gorm
Cairngorm Plateau	NN9894398898	Active search	Ben Macdui summit
Cairngorm Plateau	NH9847001457	Bugvac	Thin alpine vegetation adjacent to path
Cairngorm Plateau	NH9905502240	Bugvac	Thin alpine vegetation adjacent to path
Cairngorm Plateau	NH9962202829	Bugvac	Snow-field with thin vegetation layer of alpine mosses and plants
Cairngorm Plateau	NJ0052204057	Bugvac	South east slope of Cairn Gorm
Cairngorm Plateau	NN9894398898	Bugvac	Ben Macdui summit
Cairngorm Plateau	NN9896698836	Bugvac	Ben Macdui summit
Cairngorm Plateau	NN9902299164	Bugvac	Boulder field near the summit of Ben Macdui
Cairngorm Plateau	NH9962202829	Pitfall trap	Snow-field with thin vegetation layer of alpine mosses and plants
Cairngorm Plateau	NN9894398898	Pitfall trap	Ben Macdui summit
Cairngorm Plateau	NH9835001148	Sweep net	Thin alpine vegetation adjacent to path
Cairngorm Plateau	NH9857400016	Sweep net	Boulder field near the summit of Ben Macdui

3.7.3.2 *Mollusca*

Mollusca fieldwork was completed in 2013. We searched for molluscs in Glen Luibeg on 4 July and Glen Feshie on 7 July where we found many wet stony flushes with apparent calcareous influence. Aquatic snail shells were visible in some, indicating that conditions allowed shell preservation. A total of 20 samples were taken (1 L each). Potential flushes were identified by the presence of visible molluscs, flowering *Saxifraga aizoides*, short sedges such as *Schoenus nigricans*, short mosses and bare stony ground with surface flow. Most such flushes were on steep river terrace slopes, and stood out visually from the generally heather-dominated and wooded landscape. We did not climb any higher valley-side slopes, such as the hanging valley Coire Garbhlach.

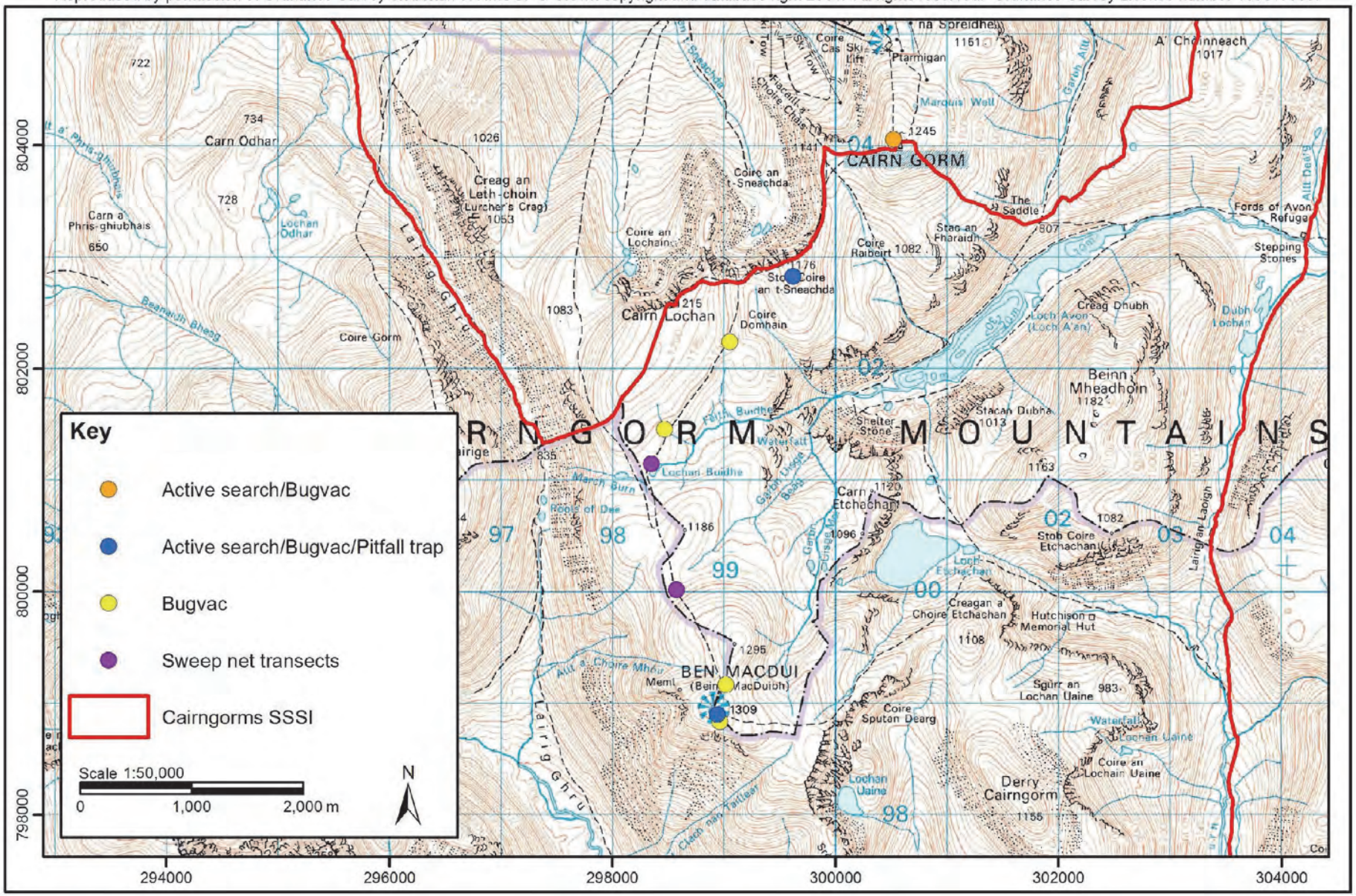

Figure 3.10. Survey locations in Cairngorms SSSI (excluding Mollusca): Cairngorm Plateau

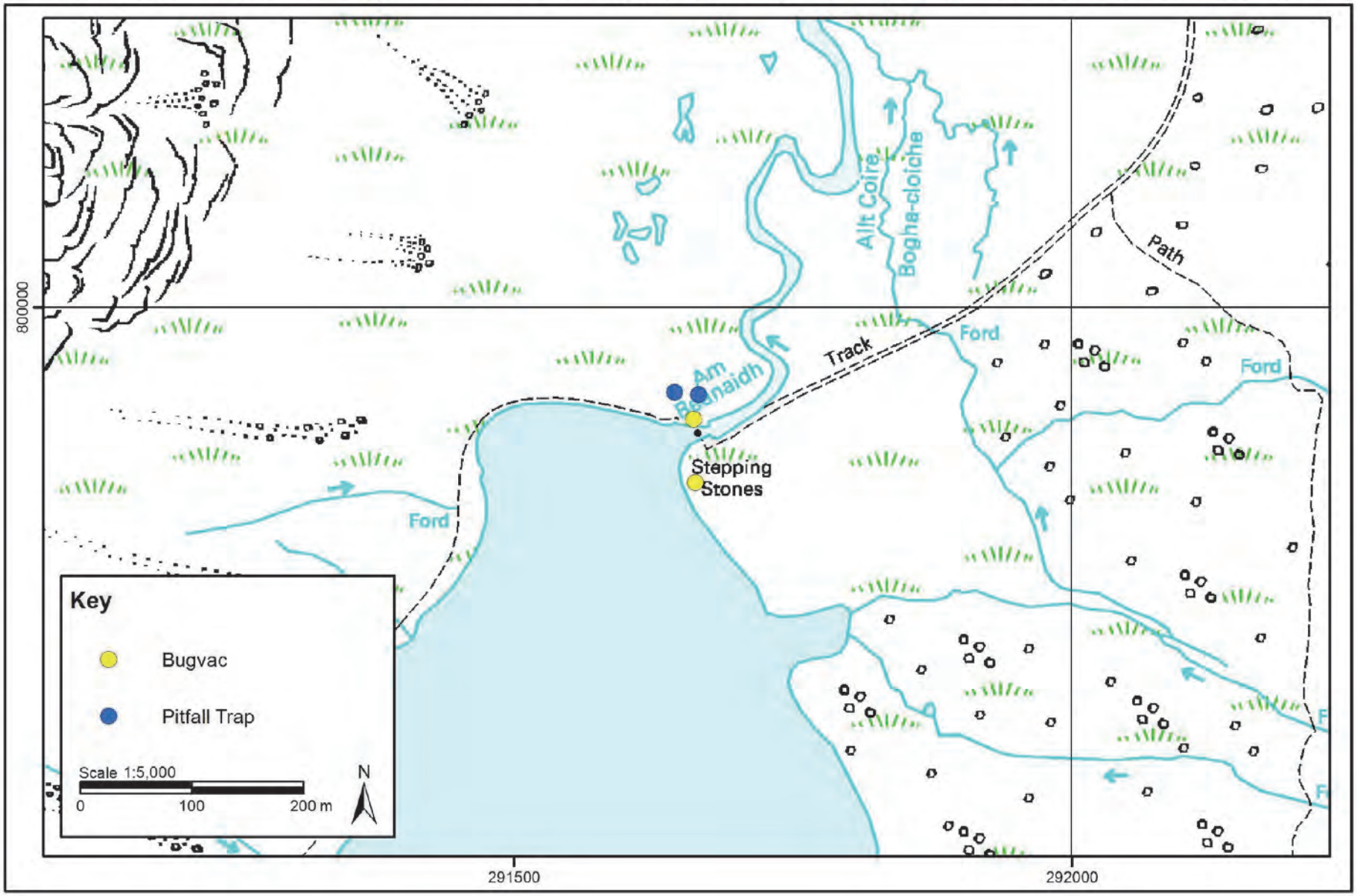

Figure 3.11. Survey locations in Cairngorms SSSI (excluding Mollusca): Loch Eaniach

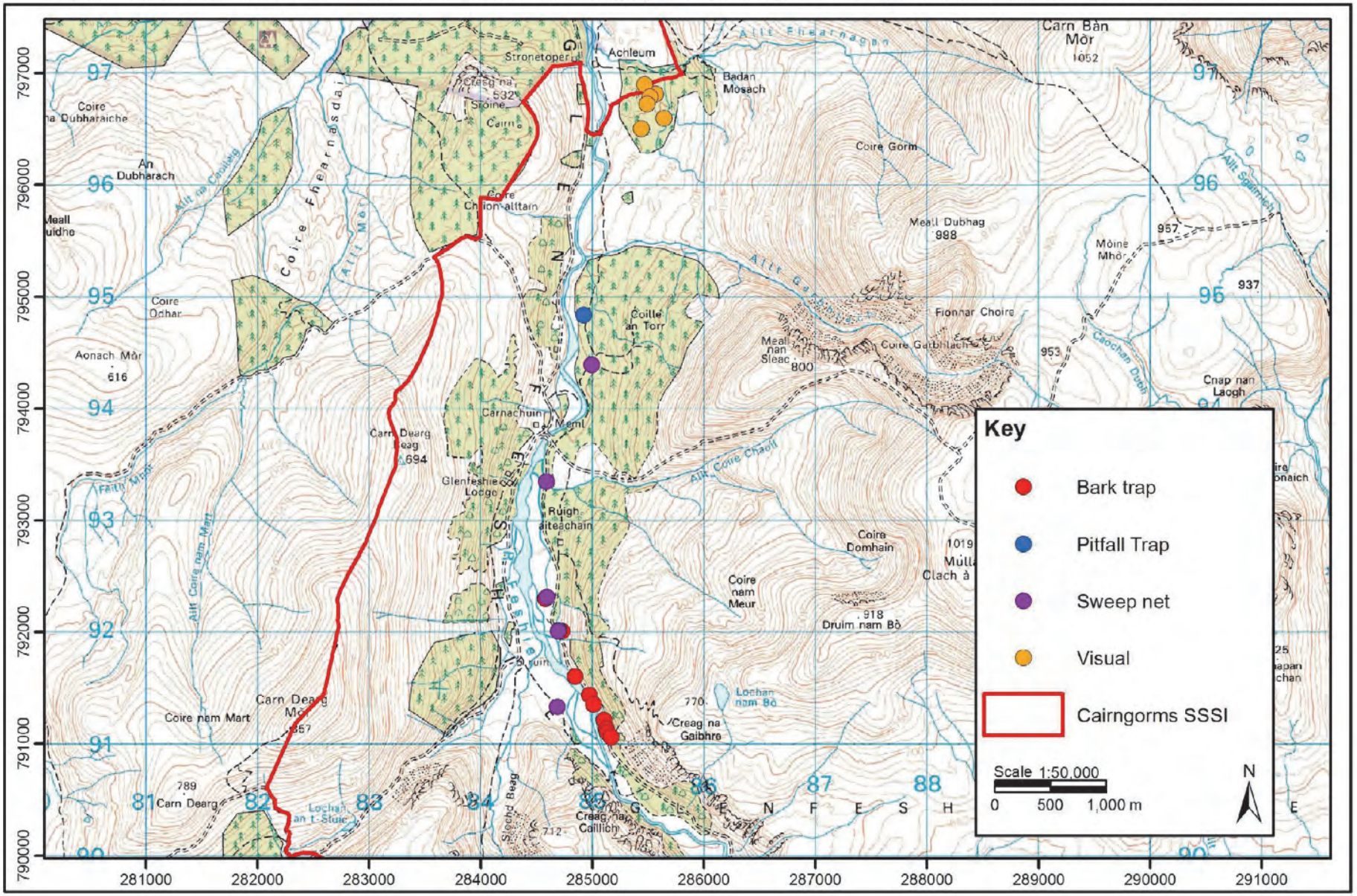

Figure 3.12. Survey locations in Cairngorms SSSI (excluding Mollusca): Glen Feshie

We also took speculative substrate and litter samples in a range of other locations, including birch wood and roadside drain debris, which may yield a variety of mollusc species. Incidental mollusc sightings were also recorded. Our objectives were to find new populations of the rare *Vertigo* species, and to increase the general mollusc knowledge of the site. Sample locations are shown in Figures 3.13, 3.14 and 3.15.

3.7.3.3 *Odonata*

Five survey locations were identified: the area adjacent to the North Rothiemurchus Pinewood SSSI, Gleann Eaniach (Figures 3.43 and 3.44), Badan Mosach in Glen Feshie (Figure 3.45) and Glen Derry and Glen Dee on the Mar Estate (Figure 3.46). Each was visited in 2013 – apart from Glen Derry (due to poor weather) - on 18 July, 19 July, 10 August and 7 July, respectively. The weather was sunny and the temperatures ranged between 15 and 25 ºC. Survey locations are shown in Figure 3.12 ('Visual').

The more remote Glen Derry site was surveyed on 23 July 2014 during a long period of hot and dry weather, perfect for observing adults on the wing. The weather on the day was excellent with the temperature at 23 ºC, a light breeze and less than 10% cloud cover. These survey locations are shown on Figure 3.16.

3.7.4 Results

3.7.4.1 *Terrestrial invertebrates*

The most speciose groups encountered were spiders (39 species) and beetles (38 species). We found the spiders *E. tirolensis*, *M. paetulus* and *H. holmgreni*, which are included in the SNH dossier; we also found *Monocephalus castineipes* (broad groove-head), and two additional nationally scarce spiders: *Erigone psychrophila* (chilled money-spider), *Macrargus carpenteri* (northern litter-spider).

We did not find any of the listed beetles, Hymenoptera or Hemiptera. We did, however, find several other nationally scarce beetles, including *Cymindis vaporariorum* (a ground beetle), *Otiorhynchus scaber* (a broad-nosed weevil), *Patrobus septentrionis* (a ground beetle) and *Trechus rubens* (a ground beetle).

The three survey sites are discussed below individually in greater detail.

Cairngorm Plateau
The invertebrate fauna collected in both the snow field (Figure 3.47) and sparsely vegetated boulder field summit areas (Figure 3.48) was typical of montane habitats. Our two most speciose groups, Araneae and Coleoptera, produced 12 and 16 species respectively, and included a number of rarities.

Mecynargus paetulus was found at NH9962202829 on 16 July and NN9902299164 on 17 July. Both records are of females collected by bugvac. The first record is from a snow field habitat at Stob Coire t-Sneachda, and the second is from a more vegetated area of the summit of Ben Macdui. This is an RDB2 species and found at elevations above 850 m under stones and associated with *N. stricta* snow field habitats. Adults of both sexes have been found between May and September in Britain, and so these records are relatively early in the season. This may reflect the relatively mild winter experienced prior to the 2013 survey. The species is listed as having been previously recorded at NN8995 (1979) and NN99 (1981) (Scottish Natural Heritage, 2003c). Given the expanse of available habitat, the species may be found elsewhere.

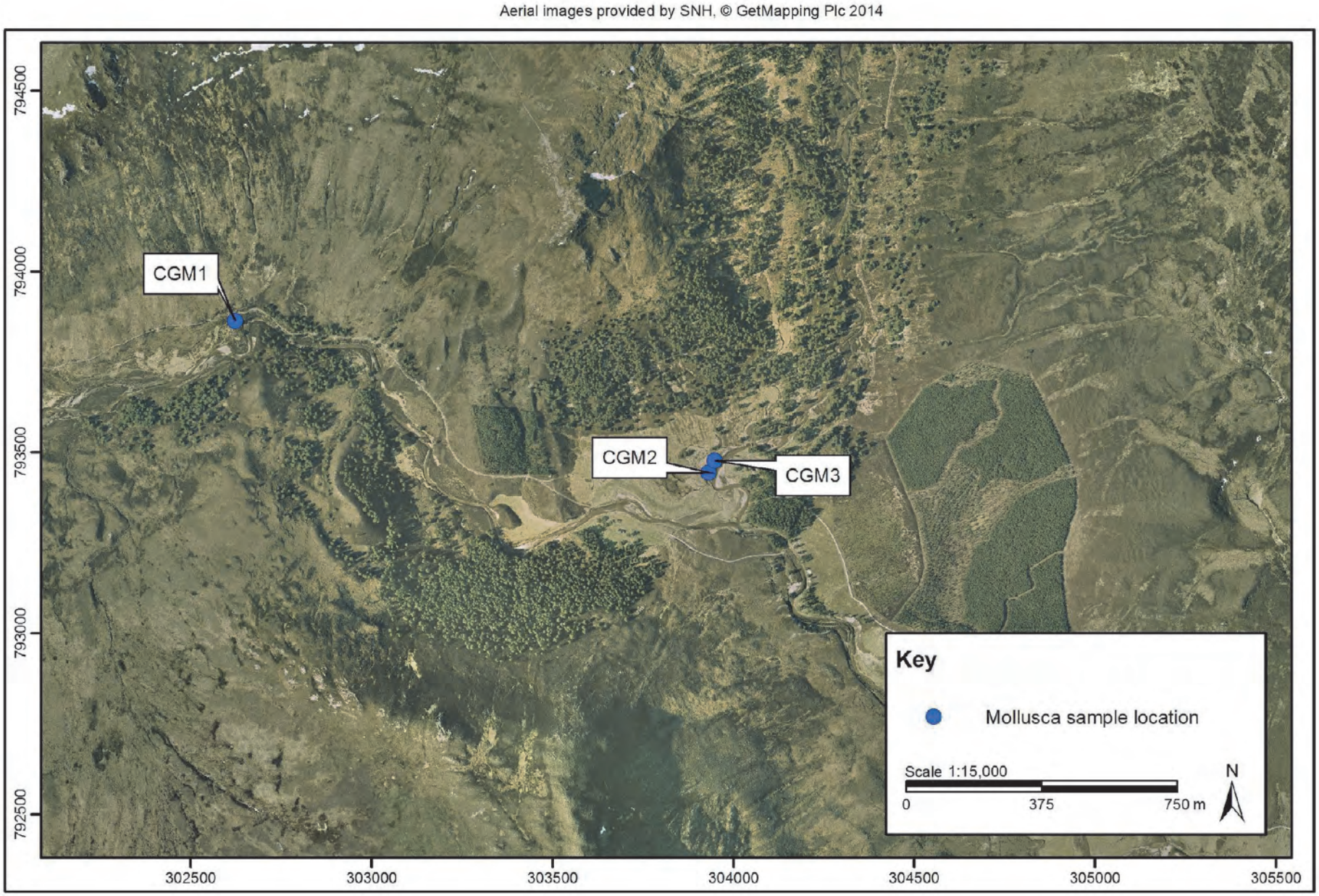

Figure 3.13. Mollusca survey locations in Cairngorms SSSI: East

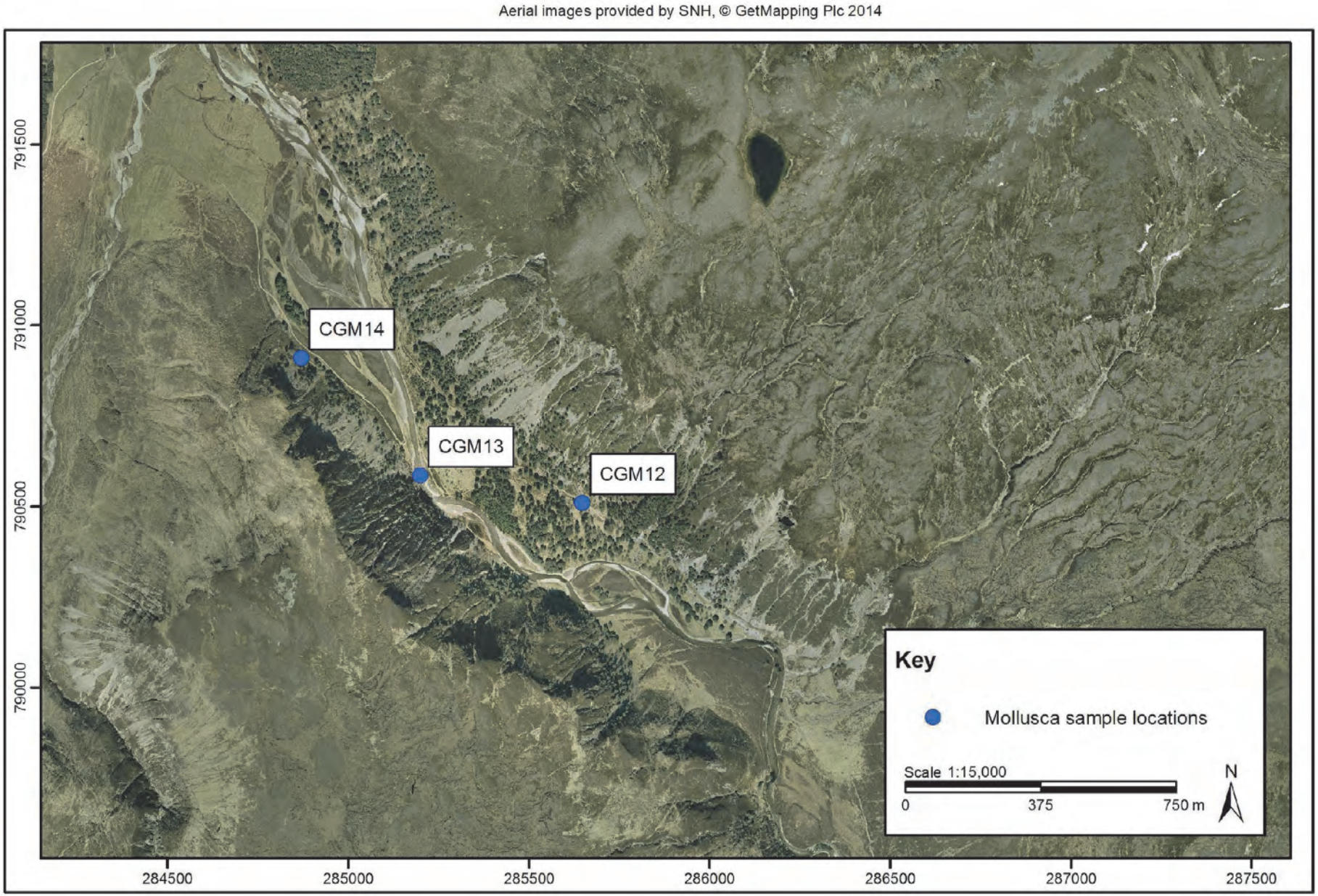

Figure 3.14. Mollusca survey locations in Cairngorms SSSI: South-west

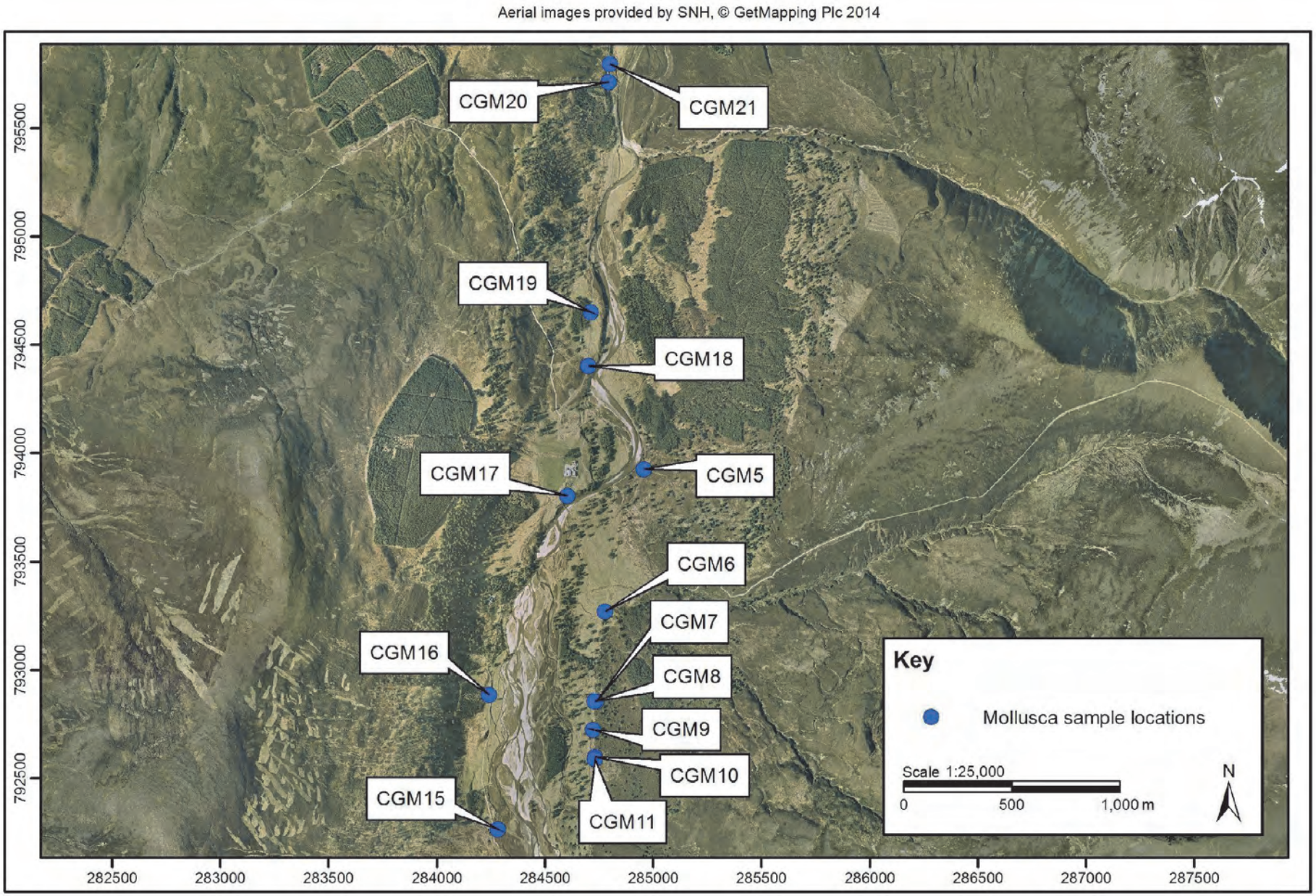

Figure 3.15. Mollusca survey locations in Cairngorms SSSI: North-west

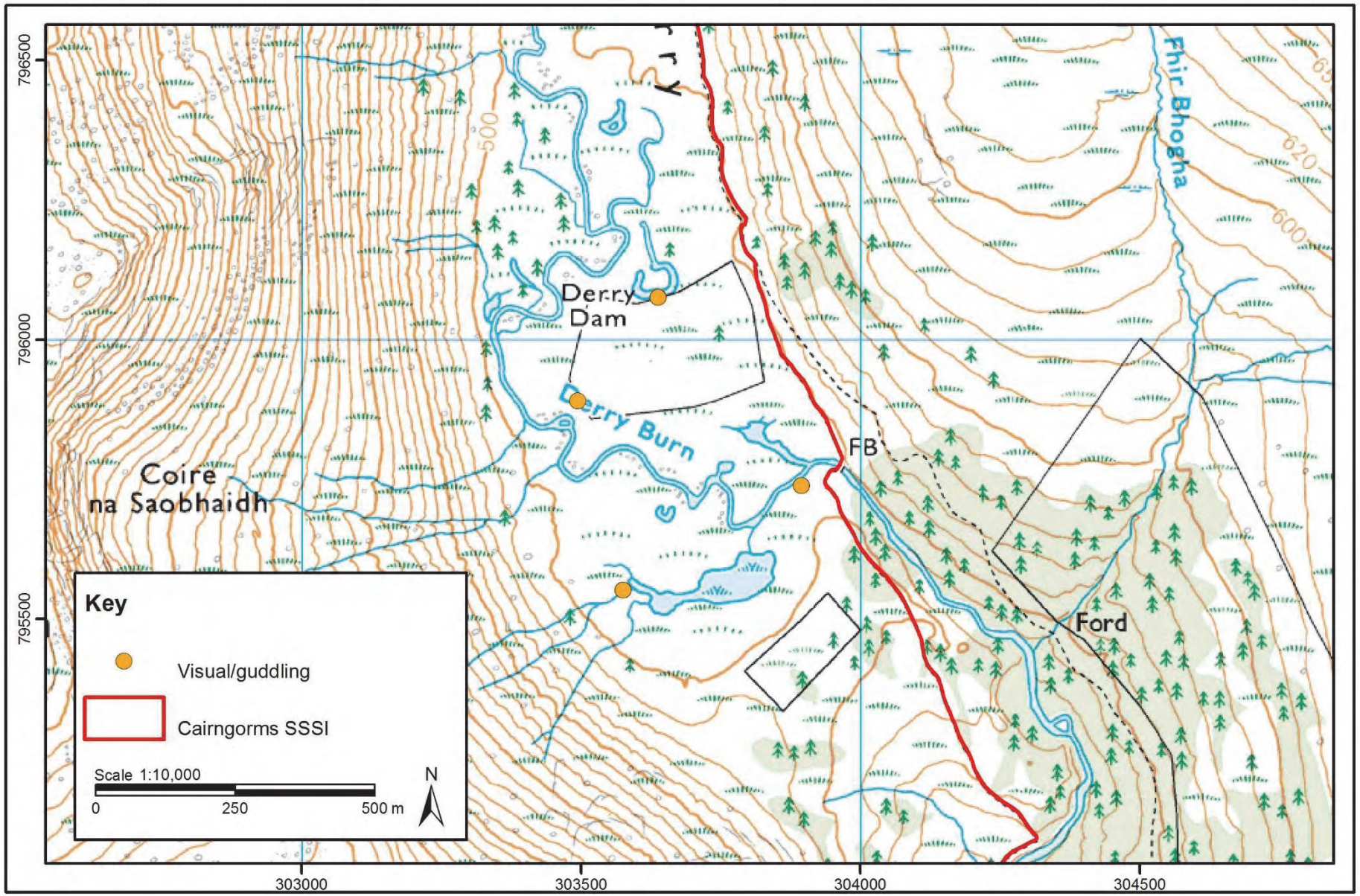

Figure 3.16. Odonata survey locations in Cairngorms SSSI: Glen Derry

Five other nationally scarce species were also recorded, all of which are associated with high elevations or montane habitat; a single female *E. psychrophila* was collected at NH9835001148 on 16 July by searching amongst loose stones. Seven *E. tirolensis* specimens were collected by bugvac (two males and one female at NJ0052204057 on 16 July and one female at NN9902299164) and at both pitfall trap transects (NN9894398898 on 30 July and 14 August and NH9961802831 on 14 August). Three *H. holmgreni* specimens were collected at two locations, both on the summit of Ben Macdui (one female was collected by bugvac NN9896698836 on 16 July and two females were collected by pitfall trap transect NN9894398898 on 30 July). Other common spiders were also collected, typical of upland habitats.

Two of the nationally scarce beetles recorded were found in pitfall traps in the snow field habitat (NH9961802831): *C. vaporariorum* (one specimen on 14 August) and *P. septentrionis* (12 specimens on 30 July and 10 specimens on 14 August). Other beetle species collected were also typical of montane habitats.

Although the Cairngorm Plateau is clearly an important and busy mountaineering destination, evidence of erosion was largely restricted to paths marked on OS maps. It should be noted that a successive series of wet summers has allowed vegetation to colonise more areas of the plateau than would be expected during the more normal dry summers (Nic Bullivant, Cairngorm Mountain Ranger Service, pers. comm.). As such, species associated with vegetation such as *N. stricta* may have been able to colonise new areas and expand their local range in recent years (e.g. *M. paetulus*).

Loch Eaniach

The peatland habitats sampled are shown in Figure 3.49 and the sparse shore vegetation is shown in Figure 3.50. Although this was the least speciose location (only nine species of spider and eight species of beetle), it produced a number of rarities.

The spider *M. castineipes* (one female) was found by bugvac, as was the nationally scarce *M. carpenteri* (one female), both at NN9166099900 on 31 July. In Scotland, both species are associated with upland moorland, and are generally found under stones. Both specimens were collected from moss at the base of dense heather, which differs slightly from the microhabitat these are normally associated with, i.e., under stones. Dense vegetation cannot be effectively sampled by traditional hand searching methods, but are quite accessible by vacuum sampling. Increased use of bugvac in invertebrate surveys may reveal new habitat associations previously undiscovered.

In addition to spiders, we found two nationally scarce beetles: *O. scaber* (a single individual in pitfall trap at NN9164499924 on 15 August) and *T. rubens* (one individual at NN9166099900 and one at NN9166399843 both on bugvac on 31 July).

Otiorhynchus scaber has a variety of food plants, including birch, alder and pine. It is predominantly arboreal and nocturnal, and found in montane and submontane areas in central Europe and the northern Balkans (Morris, 1997). It is interesting to note that this species was also found in the Scots pine forest in Glen Feshie, and so occurs in both the traditional British arboreal habitat and continental montane habitat within the Cairngorms.

Loch Eaniach is a popular cycling destination, with a very busy path on days with good weather. Cyclists appear to keep to the marked path, however, and there was no evidence of erosion of habitats. The shore of Loch Eaniach is commonly used for picnic lunches and we noted that some litter was present.

Glen Feshie
The most speciose of the three locations, with 18 and 14 species of spiders and beetles, respectively. Glen Feshie offers open and thick Caledonian pine forest with several rides for estate management and hiking. The hard core tracks and paths create a micro-climate in which *O. uncinata* could flourish, but none was found during the sweep net transects.

The nationally scarce broad-nosed weevil, *O. scaber*, was found in pitfall traps at NN8492894837 (six specimens) on 30 July at Coille an Torr (Figure 3.51). We also found *F. lugubris.*

While Glen Feshie was the most speciose location surveyed, the majority of species were common and widespread, reflecting the lower elevation and less unique habitats of this valley compared with the other sample sites.

Glen Feshie is more easily accessible than the other two locations and is used by many outdoor enthusiasts throughout the year. Paths are well-maintained, however, and there was no evidence of erosion of habitats. This is a popular camping destination, but this activity tends to be focused around the bothy. There was evidence that campers had used fallen trees for firewood but a sign had been erected by Thomas McDonnell instructing people not to do this so as to allow the wood to decay for invertebrate habitat (Figure 3.52).

3.7.4.2 *Lepidoptera*

Although it was not possible to complete Lepidoptera surveys in 2013, the site was found to offer ample habitat and foot plants for all species of moth listed, and *P. sobrina* was found on the nearby Abernethy Forest SSSI and Alvie SSSI.

3.7.4.3 *Mollusca*

We recorded 17 snail, slug and bivalve species but no *Vertigo* spp. and no rare or otherwise unusual species. Species found include *Aegopinella nitidula, A. pura, Arianta arbustorum, Arion ater, Cepaea hortensis, Cochlicopa lubrica, C. lubricella, Columella aspera, Euconulus fulvus, Galba truncatula, Nesovitrea hammonis, Oxychilus* sp.*, Pisidium personatum, Punctum pygmaeum, Radix balthica, Vitrea contracta* and *Vitrina pellucida.* These results are summarised in Table 3.11.

Table 3.11. Cairngorms Mollusca results

Grid reference	Location	Habitat	Mollusc spp.
NO0262393864	Glen Luibeg	Heather/moss litter	
NO0393293444	Glen Luibeg	Oxbow bog pool litter	
NO0394993477	Glen Luibeg	Oxbow stony pool substrate	
NN8495793927	Glen Feshie, east side	Muddy rivulet/burn	2
NN8477893270	Glen Feshie, east side	Grass litter	3
NN8473792855	Glen Feshie, east side	Wet stony flush	1
NN8472992856	Glen Feshie, east side	Wet gravelly flush	2
NN8472292724	Glen Feshie, east side	Pine/alder wood litter	
NN8473192600	Glen Feshie, east side	Wet narrow stony flush	1
NN8473192588	Glen Feshie, east side	Wet stony flush	3
NN8564890510	Glen Feshie, east side	Mossy scree	2
NN8520090586	Glen Feshie river bed	Dried channel pool	
NN8487090910	Glen Feshie, west side	Wet steep stony flush	1

Grid reference	Location	Habitat	Mollusc spp.
NN8428392265	Glen Feshie, west side	Burn edge moss/slime	
NN8424192885	Glen Feshie, west side	Birch/rowan woodland litter	2
NN8460493804	Glen Feshie, west side	Road drain debris	5
NN8470194402	Glen Feshie, west side	Roadside litter/debris	3
NN8471294651	Glen Feshie, west side	Road drain debris	5
NN8479495712	Glen Feshie, west side	Debris beside roadside drain	6
NN8480095796	Glen Feshie, west side	Wet stony flush	1

3.7.4.4 *Odonata*

Nine species were recorded in 2013 (Table 3.12). Good populations of *L. dubia* were found in Glen Feshie and east of Lochan Deo (Figures 3.53 and 3.54). The other species of Odonata recorded are widespread in Speyside. Only four species were found in Glen Dee, which reflects the site's altitude of 480 m.

The visit to Glen Derry in 2014 yielded five species, with breeding proved for three of these (Table 3.12 and Figure 3.55). All of these species had been detected during 2013 surveys at the other sites in the Cairngorms SSSI. The species assemblage found at Glen Derry was more diverse than expected, although the lack of any *Libellula quadrimaculata* (four-spotted chaser) sightings was puzzling, as the habitat was suitable. Most of the water bodies sampled originated from meanders in the Derry Burn, meaning that they had a more complex morphology than the bog pools surveyed in Glen Dee and a greater diversity of emergent macrophytes such as bogbean (*Menyanthes trifoliate*) and bottle sedge (*Carex rostrate*). This greater variety of habitat allows a good diversity of species to exist here, despite an altitude of 490 m.

Table 3.12. List of Odonata species recorded in Cairngorms SSSI compared with species recorded from this area historically

Possible Species	Cairngorms Sites 2013 SCM	Glen Derry 2014 SCM
Aeshna caerulea (azure hawker)*		
Aeshna juncea (common hawker)	X b	X b
Coenagrion hastulatum (northern damselfly)		
Cordulegaster boltonii (golden-ringed dragonfly)	X	X
Enallagma cyathigerum (common blue damselfly)	X	
Ischnura elegans (blue-tailed damselfly)	X b	
Lestes sponsa (emerald damselfly)	X	X
Leuchorrhinia dubia (white-faced darter)	X b	
Libellula quadrimaculata (four-spotted chaser)	X b	
Pyrrhosoma nymphula (large red damselfly)	X b	X b
Somatochlora arctica (northern emerald)		
Sympetrum danae (black darter)	X b	X b
Sympetrum striolatum (common darter)		
Total	9/6b	5/3b

X = present; b = evidence of breeding
** Records of this species are considered to be questionable in this area*

3.7.5 Site condition evaluation

3.7.5.1 *Araneae*

The Cairngorm Plateau supports the greatest number of spiders of conservation concern, compared with the other locations surveyed. This is unsurprising and is due to the unique nature of that habitat in a UK context. Loch Eaniach also has spiders of conservation importance which were not found on the plateau. Glen Feshie did not reveal any rare spiders, but it did support the greatest number of species. Evidence of human-caused erosion is largely restricted to paths marked on OS maps (Figure 3.56). The delicate habitats occupied by rare spiders such as snow fields were generally undisturbed. The survey demonstrated that this area supports an excellent montane spider fauna, despite the limited scope of this survey.

3.7.5.2 *Coleoptera*

Glen Feshie offers excellent habitat for saproxylic species such as *A. tristis* and *A. sanguinolenta*, as well as for fungal specialists such as *O. ferrugineum*. Despite being more accessible than the montane habitats within the Cairngorms SSSI, evidence of human-caused erosion was minimal. The nationally scarce weevil *O. scaber* is considered to be arboreal in Britain, and is associated with birch and pines. In areas of central Europe this species is, however, also found in montane and submontane habitats (Morris, 1997). The species occupies both habitat types in the Cairngorms SSSI, perhaps reflecting the unique continental and alpine environments of this large site.

3.7.5.3 *Hemiptera*

Although we did not find *Z. nigriceps* or *E. abietus*, juniper was present in Glen Feshie, and suitable habitat available for both species (Figures 3.51 and 3.57).

3.7.5.4 *Hymenoptera*

Although most of the forest is quite open, Glen Feshie offers a diverse range of Caledonian forest environments including more dense habitats. All species were found at nearby sites, and so they are certainly present in the wider area. It is likely, therefore, that these species persist within their particular niches in Glen Feshie. We did not find *O. uncinata*, although Glen Feshie offers ample suitable habitat for this species. We did find this solitary bee at the nearby Abernethy Forest, so it is definitely present in the wider area. There is no identifiable reason for this species not to persist in Glen Feshie based on available information, although we have only limited knowledge of its ecology and its nest preferences have yet to be identified.

3.7.5.5 *Lepidoptera*

Although we were unable to complete moth trapping, the site was found to offer ample habitat and food plants for all of the species listed in site documentation. Both the montane habitats and Caledonian forest in Glen Feshie were found to be in excellent condition based on the results of surveys for other taxa. We also found *P. sobrina* in the nearby Abernethy Forest and Alvie SSSIs, confirming its continued presence in the wider area.

3.7.5.6 *Mollusca*

Although we did not locate any *Vertigo* species – particularly *V. geyeri* and *V. alpestris* – it is possible that populations remain undiscovered. As the site covers such an extensive area, exhaustive surveys for molluscs would be logistically impractical.

3.7.5.7 *Odonata*

Nine of the possible twelve species that have been reported here historically were recorded, with breeding proven for six (Table 3.12). An additional species the azure damselfly (*Coenagrion puella*) has been recorded recently in Speyside and is likely to colonise the lower altitudes sites here in due course, bringing the Odonata fauna to 13. The lack of sightings of *Sympetrum striolatum* is not surprising, as its distribution is patchy in this area.

The lack of sightings of *C. hastulatum* was a little surprising. One site for this species was identified near Loch Gamhna in Smith & Smith (1996), and unfortunately there was not sufficient time to visit it as efforts were focused on more extensive areas of suitable habitat near known populations. It is suspected that there is a breeding population in the Rothiemurchus part of the Cairngorms SSSI, as it is between known populations in Inshriach (Willet, 2008) and North Rothiemurchus Pinewood SSSI.

Glen Feshie would certainly warrant further survey as it is certainly under-recorded and may hold interesting and important Odonata populations.

3.7.6 Site management recommendations

We found a number of new rare invertebrate species during our surveys, and it is recommended that these taxa are included in future SCM. It is also worth noting that the site is extremely large and dominated by inhospitable terrain which is difficult to access. This survey was only able to include a small area, and it is likely that species associated with the Cairngorm Plateau in particular may be more widespread, and that other rare species are likely to exist elsewhere. We would recommend a wider invertebrate survey of the plateau.

In general, we would recommend that paths are continued to be well-maintained in order to encourage outdoor enthusiasts to avoid important semi-natural habitats. There is already excellent information about the montane habitats at Cairngorm Mountain, which advises people of the importance of the habitats on the plateau, and how to have a minimal impact on this environment. At present, walkers must ascend the hill to access the plateau, despite the presence of the funicular railway. There are, however, guided tours now available to tourists leaving from the Ptarmigan Top Station, on Cairn Gorm. This should be encouraged, as it allows more people to encounter this very special environment in a controlled manner and hopefully demonstrates why it needs to be protected. It is important, though, that the numbers of available walks are limited and restricted to routes marked on the OS map. It is strongly recommended that free access should not be permitted to people using the funicular to access the plateau. Aside from the health and safety risks, there would be a likelihood of increased erosion to semi-natural habitats. Consideration should be given to maintaining an interpretation board at the start of the cycle path to Loch Eaniach, providing information on the unique habitats and important species living in this area. This will enhance their experience and may reduce litter left at the shore of Loch Eaniach.

Specific recommendations are given for individual taxa below, where relevant.

3.7.6.1 *Araneae*

As the Cairngorm Plateau and Loch Eaniach offer the greatest number of species of conservation concern, we recommend that these sites are targeted for future SCM. While Glen Feshie offers excellent habitat, the species present are common and widespread. Other SSSIs nearby appear to offer more important spider communities associated with similar woodland habitats.

3.7.6.2 *Coleoptera*

We recommend that signs are maintained in Glen Feshie instructing that deadwood should not be taken as firewood by campers. Interpretation boards may help to inform people of the importance of this habitat. Consideration should also be given to a management plan to ensure continued and sustainable supplies of a variety of deadwood resources.

3.7.6.3 *Hemiptera*

Any management should ensure the continued presence of juniper.

3.7.6.4 *Hymenoptera*

Open glades and rides should be maintained to provide suitable habitat for *O. uncinata*. Further research is required to determine the nesting requirements of this species. Until this has been confirmed, we recommend the continued use of sweep netting transects in good weather conditions.

3.7.6.5 *Lepidoptera*

Any management should ensure the continued presence of a diverse flora.

3.7.6.6 *Mollusca*

As it is possible that undiscovered populations of rare *Vertigo* species exist, particularly in upper slopes of Glen Feshie and side valleys, this should be considered in any future surveys or management plans.

3.7.6.7 *Odonata*

Other than blocking drainage channels in historically drained wetlands throughout the site, there are no Odonata specific site management recommendations.

3.8 Crathie Wood

3.8.1 Site description

Crathie Wood covers an area of 193 ha situated on the slopes of Creag a Chlamhain by the village of Crathie. The site consists mainly of pine-birch woodland, along with birch woodland, juniper scrub and dwarf-shrub heath.

The site offers the best example of upland birch-pine woodland in Deeside, and one of the finest in Scotland. It has an unusual variety of canopy species, including aspen, with mixed age classes and a shrub layer rich in juniper. In addition, lime-rich drainage from calcareous rocks above has contributed towards the unusually diverse field layer. The calcareous rocks also support a number of rare species of plant normally found at higher elevations.

The site supports a number of biological features, including native pinewood, upland birch woodland and juniper scrub as well as the invertebrate assemblage.

3.8.2 Summary of known invertebrate interests

The notified invertebrate assemblage feature was surveyed, which includes one Hemiptera, *Zygimus nigriceps*, and Lepidoptera.

3.8.2.1 *Lepidoptera*

Exaeretia ciniflonella
This micro-moth (family Oecophoridae) is considered to be a rare localised species in Britain, occurring only among birch in parts of the Scottish Highlands. The adults fly in July and August, and are known to come to light after dark. The larvae feed on birch within a retreat of a rolled or folded leaf.

Aricia artaxerxes (northern brown argus)
Aricia artaxerxes is found only in the north of England and Scotland; the *artaxerxes* subspecies is endemic to Scotland in the UK. The larval food plant is common rock-rose (*Helianthemum nummularium*) and the butterfly is found on sunny, south-facing slopes and hollows on calcareous soils. In Scotland, adults emerge towards the end of June, peaking in the middle of July. It is considered to be a scarce species in the UK.

3.8.2.2 *Mollusca*

Vertigo alpestris (the mountain whorl snail) RDB3
Vertigo alpestris is a minute species that inhabits limestone screes, walls and rocks, with few populations in Scotland. It was considered as declining in the UK by Cameron & Killeen (2001). The citation for Crathie Wood mentions *V. alpestris,* but gives no details of locations, status or discovery. Richard Marriott (pers. comm.) found *V. alpestris* by examining the undersides of moss-covered stones in birch wood near a former quarry.

3.8.3 Methods

Fieldwork was completed in 2013.

3.8.3.1 *Terrestrial invertebrates*

The survey was carried out on 23 July and 5 August. Days were chosen when the weather was dry, warm and not too windy so as to hamper sweep netting. Heavy rain on the afternoon of 23 July caused sampling to be cut short on that day.

The main food plant of *Z. nigriceps*, juniper, was searched by beating branches into a large, white sweep net bag. The contents of the bag were then searched. Patches of juniper scrub were searched across the site (Table 3.13 and Figure 3.17). When a search location was selected, a grid reference was taken and individual juniper bushes were sampled within a 30 m radius. Scots pine was also beaten, as this is recorded as a food plant in some literature (Southwood & Leston, 1959).

Table 3.13. Crathie Wood terrestrial invertebrate sample locations

Grid reference	Location description
NO2722095279	Birch dominated area of woodland, scattered Scots pine
NO2746595487	Birch dominated area of woodland, Scots pine occasional
NO2758695637	Birch and Scots pine woodland
NO2706495485	Birch and Scots pine woodland
NO2693394426	Birch and aspen woodland
NO2679394409	Birch and aspen woodland
NO2817395695	Birch and Scots pine woodland
NO2791895789	Birch and Scots pine woodland
NO2796295911	Birch and Scots pine woodland

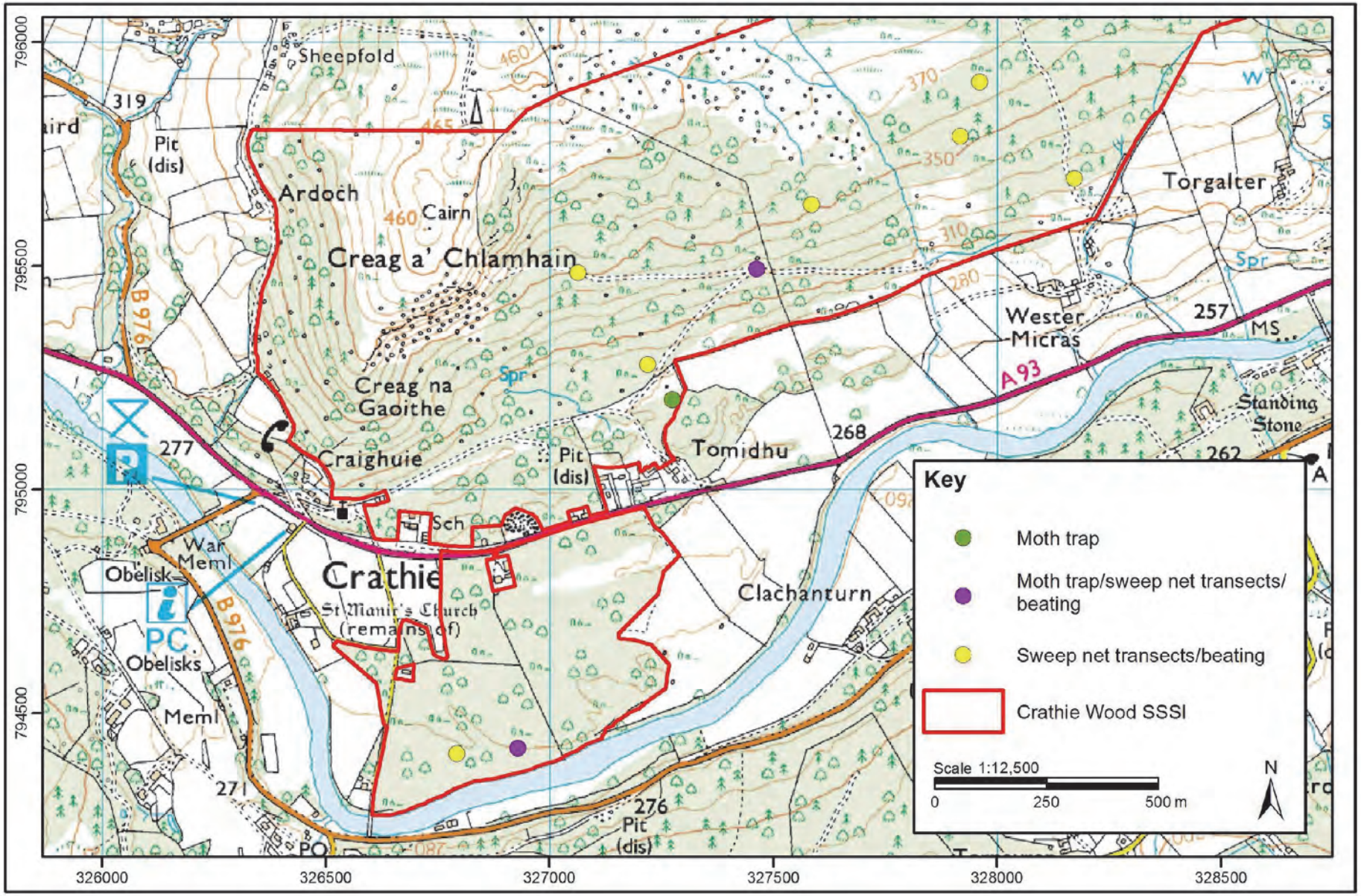

Figure 3.17. Terrestrial invertebrate survey locations in Crathie Wood SSSI

3.8.3.2 *Lepidoptera*

Exaeretia ciniflonella: we used a heath moth trap on the evenings of 22 July, 4 August and 5 August. Dry, warm evenings with low wind and cloudy conditions when moths are more likely to be active were chosen for trapping. All moths caught were identified to species. Three sites were surveyed using the moth trap (Table 3.14, Figure 3.17).

Table 3.14. Crathie Wood moth trap locations

Grid reference	Location description
NO2693094422	Mixed birch and Scots pine with juniper understory
NO2727595201	Mixed birch and aspen woodland
NO2746395493	Mixed birch and Scots pine with juniper understory

Aricia artaxerxes: adults were searched on sunny, calm days in suitable habitat – woodland glades and outcrops supporting common rock-rose.

3.8.3.3 *Mollusca*

As it would be too labour-intensive and logistically impractical to search for *Vertigo* species by eye in the field in a systematic and repeatable fashion, we used a standardised sampling method with off-site processing and identification. We took 10 samples spaced over several hundred metres, each consisting of bulk 1 L litter and substrate from mossy limestone rubble and scree locations with a birch wood canopy. Two samples were on lower slopes around 330 m elevation, the remaining were in a rough transect at altitudes of 370-400 m. We focused most of our efforts on this upper slope area, which is a series of disused quarries towards the west end of the site, cut into the Dalradian limestone scarp (Figure 3.58). They are reached by ascending a linear path that traverses the slope from east to west (Table 3.15, Figure 3.18). We believe that it was in this area that Richard Marriott previously recorded *V. alpestris.*

Table 3.15. Crathie Wood Mollusca sample locations

Grid ref	Location description
NO2654695096	Mossy scree in birch wood
NO2723795463	Mossy scree in birch wood
NO2694395494	Mossy scree at base of quarry rock face
NO2693295516	Litter at base of quarry rock face
NO2693395509	Mossy scree in birch wood
NO2691895496	Moss/bracken scree in birch wood
NO2690895490	Base of quarry rock face in birch wood
NO2689995484	Mossy scree in birch wood
NO2687595468	Scree in birch wood
NO2686895495	Mossy scree at base of quarry rock face

3.8.4 Results

3.8.4.1 *Terrestrial invertebrates*

Although *Z. nigriceps* was not found, suitable habitat was present throughout the site (e.g., Figure 3.59).

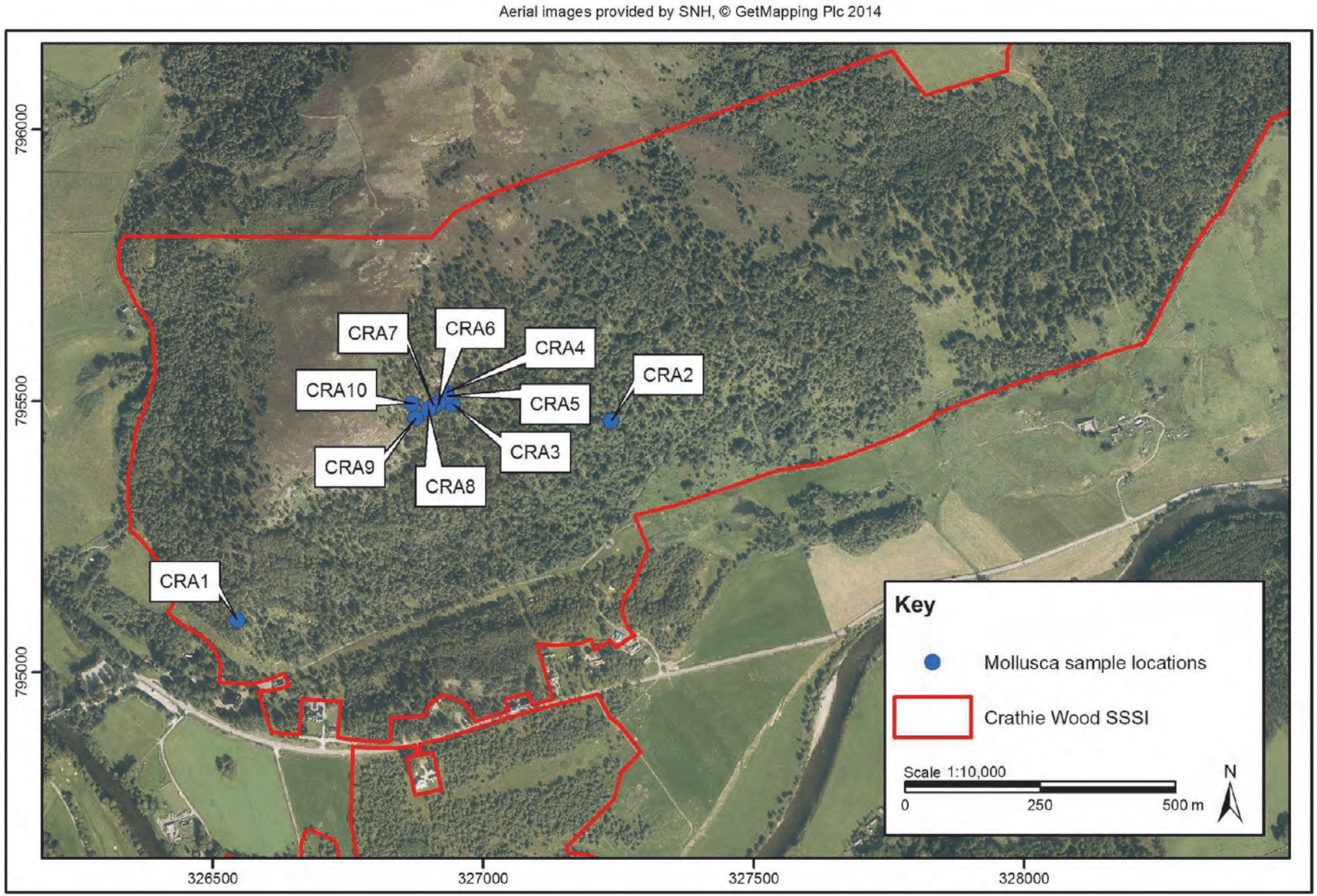

Figure 3.18. Mollusca sample locations in Crathie Wood SSSI

3.8.4.2 *Lepidoptera*

Thirty-one species of moth were recorded during the survey of Crathie Wood. Although *E. ciniflonella* was not observed, one male *Epione vespertaria* (dark-bordered beauty) was found at NO2727595201. This is a RDB3 species. Adult *A. artaxerxes* were found at three locations:

Creag à Chlamheim NO2678095513 (Figure 3.60): calcareous outcrop on top of hill, above the old quarry. Rock-rose was present and nectar sources wild thyme (*Thymus polytrichus*) and wood sage (*Teucrium scorodonia*) were common. Approximately 20 individuals were observed. Two adults were also seen further down the slope in birch woodland, on a grassy bank which was open to the sun and had patches of rockrose and wild thyme.

Along track NO2740895445: two adults were observed beside track in a sunny clearing. Rock-rose was found to be present here in small patches.

Telegraph way-leave NO2663894998: small quarry on the western edge of the site, close to house. Rock-rose was dense, and nectar sources wood sage and self heal (*Prunella vulgaris*) were present. One adult was seen feeding on marsh thistle (*Cirsium palustre*).

A dense patch of rock-rose by the caravans at NO2709495181 was searched for adults but none were seen; few nectar sources were available here and grazing levels (rabbits) were high. A sunny glade within birch and Scots pine woodland at NO2751395511 was found to contain rock-rose and wild thyme, but no adults were observed.

3.8.4.3 *Mollusca*

We found five *V. alpestris* shells, all of which seemed fresh (so the animals were probably alive at the time of sampling) in only one sample, at the base of a former quarry rock face (Figure 3.61). The common vertiginid *Columella aspera* appeared in 9/10 of our samples. We identified abundant mollusc shells in the Crathie samples (over 700 in total), representing 17 species, including *V. alpestris* (Table 3.16). Two slug species were also recorded on site. The number of species varied between four and 12 per sample, and some species were remarkably consistent.

Table 3.16. Crathie Wood Mollusca results

Grid ref	Habitat	***Vertigo alpestris***	**Total mollusc spp.**
NO2654695096	Mossy scree		5
NO2723795463	Mossy scree		9
NO2694395494	Mossy scree/rock face litter		4
NO2693295516	Rock face litter		9
NO2693395509	Mossy scree		13
NO2691895496	Moss/bracken scree		12
NO2690895490	Rock face litter	4ad,1juv	11
NO2689995484	Mossy scree		12
NO2687595468	Scree		9
NO2686895495	Mossy scree		12

ad = adult; juv = juvenile

3.8.5 Site condition evaluation

3.8.5.1 *Hemiptera*

Juniper, the main food plant for *Z. nigriceps*, is plentiful across the woodland and a mixture of ages and structural types are present. Scots pine is also abundant.

3.8.5.2 *Lepidoptera*

The sole food plant of *A. artaxerxes*, rock-rose, was seen occasionally to frequently, and was most prevalent along tracks and in open grassy glades. Nectar resources such as wild thyme and marsh thistle are common across the site. Rabbits are plentiful and are likely to keep the sward low enough for wild thyme and rockrose to flourish.

There is suitable open habitat for this butterfly at the locations where adults were observed. A considerable area of the woodland contains dense stands of bracken and more suitable habitat could, however, be made available if bracken were controlled.

Birch – the larval food plant of *E. ciniflonella* – is generally dominant across the site. The majority of trees are mature and little regeneration and young growth was observed, except where exclusion zones had been set up close to the river. This is likely to be a result of overgrazing by deer.

The site was found to support important moth populations. Due to the bracken encroachment, however, the suitability for the site to continue to support these populations is declining.

3.8.5.3 *Mollusca*

Vertigo alpestris either exists at low densities or its occurrence is localised. We found one juvenile shell, which shows that a breeding population exists, but we cannot say how extensive or large it is. It is also difficult to determine whether the status of the species is changing without any quantitative baseline data. A more extensive survey would be needed to determine the distribution and population status on the site. As anticipated by Richard Marriott (pers. comm.), *M. obscura* is widespread in the quarry areas.

3.8.6 Site management recommendations

For Hemiptera, any management should ensure the continued presence of juniper. For Lepidoptera, it is essential that management is undertaken to ensure that bracken does not encroach onto further suitable *A. artaxerxes* breeding and foraging habitat. A survey should be undertaken to map existing bracken and this should then be controlled so as to create additional areas of suitable habitat with sunny glades for *A. artaxerxes*. This would also provide additional habitat for other butterflies and sun-loving insects such as bees.

For Mollusca, without a fuller understanding of the species' status on site, management recommendations would be misplaced, other than to safeguard the site in its present condition. There are extensive habitats on site that appear to be suitable for *V. alpestris.* From the limited information gathered in this survey, the rock faces of the disused quarries appear to be an important feature to safeguard, but considering the original discovery, the wooded screes may also be important (R. Marriott, pers. comm.).

3.9 Dollar Glen

3.9.1 Site description

Dollar Glen SSSI covers an area of 182 ha that includes Dollar Glen itself and part of the area around the Burn of Sorrow. The site supports upland mixed ash woodland, subalpine flushes (including alkaline fens, acid flushes and springheads and rills), and subalpine calcareous grassland.

Dollar Glen is the largest, least disturbed example of a deep, narrow, steep-sided gorge supporting long-establish woodland in Clackmannanshire. The woodland is well structured and supports many species of rare vascular plants and bryophytes. The upper areas provide the best examples of subalpine flushes and calcareous grasslands in Clackmannanshire, supporting a range of plant species. Other flushes also lie in a matrix of habitats dominated by acid grassland.

The site supports a number of biological features, including upland ash woodland, subalpine flushes and subalpine calcareous grassland as well as the invertebrate feature, the beetle *Stenus glacialis*.

3.9.2 Summary of known invertebrate interests

Notified beetle feature.

Stenus glacialis RDB1
Stenus glacialis is a Stapylinidae species usually found on scree or ranker at altitudes above 700 m. *Stenus glacialis* has been collected from the sheltered slopes of King's Seat Hill where the topography allows snow to lie for an extended period, providing a cooler microclimate at lower elevations where this species is normally encountered (Richard Lyszkowski, pers. comm.). Like other *Stenus* spp., *S. glacialis* is a diurnal hunter with a hairy labium that sticks to the prey (springtails) similarly to a chameleon (Lott & Anderson, 2011).

3.9.3 Methods

Two transects of pitfall traps were set on 29 July 2013 on King's Seat Hill, south of the Burn of Sorrow, which provides suitable habitat (Table 3.17, Figure 3.19). Traps were collected on 12 August 2013.

Table 3.17. Sample locations at Dollar Glen

Grid reference	Sampling method	Location description
NS9365899777	Pitfall Trap	Grazed Moorland
NN9340200000	Pitfall Trap	Grazed Moorland

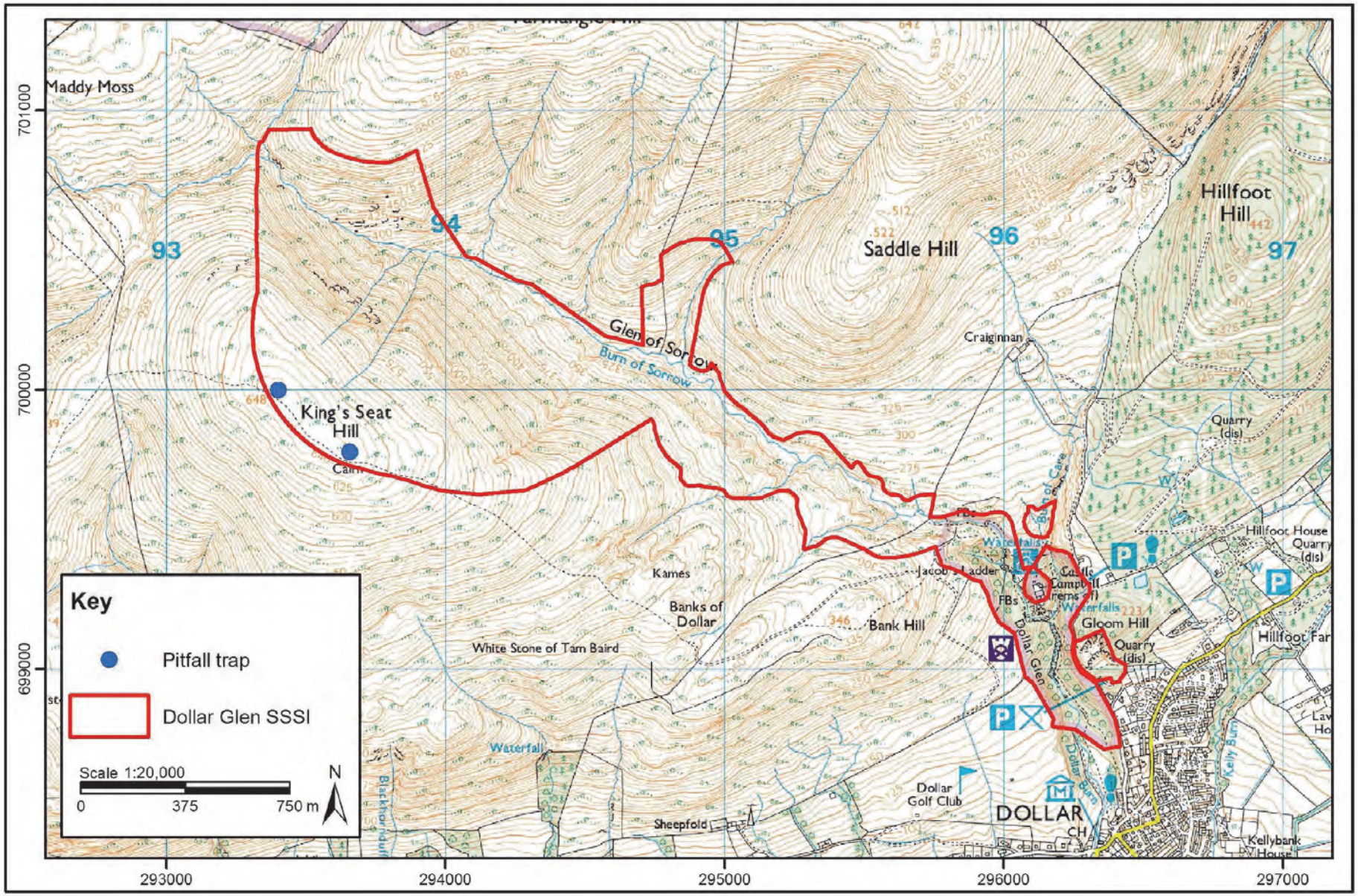

Figure 3.19. Sample locations in Dollar Glen SSSI

3.9.4 Results

Stenus glacialis was not found. The microclimate for this species is very specific and the pitfall trap transects may have missed the exact spots. The habitat surrounding the Burn of Sorrow consists of heavily grazed grassland with the lower slopes closest to the burn covered completely in bracken (Figure 3.62). Despite the apparently poor habitat, a plentiful supply of springtails was observed and caught in pitfall traps. As other predators specialising in springtails were found, such as *Notiophilus biguttatus*, habitat is clearly suitable for such animals and it is likely that *S. glacialis* is still present. It should be noted that only one individual *S. glacialis* was collected by Richard Lyszkowski during his work on the site, and so it is possible the species is present at low densities compared to other springtail predators, which may be a reflection on the unusually low elevation. We did collect five specimens of the nationally scarce ground beetle *Patrobus septentrionis* at NS9365899777 on 12 August. This species has a local distribution and is found on mountain tops (Luff, 2007).

3.9.5 Site condition evaluation

The site offered appropriate climatic conditions and a plentiful supply of springtail prey. There is a risk that bracken encroachment may spread to important habitat for this species. While this is not yet affecting the site condition, it is a factor that should be monitored and controlled if necessary. The habitat quality remains favourable for rare montane beetles.

3.9.6 Site management recommendations

The bracken distribution should be mapped and monitored. If it is found to spread, control measures should be taken or the condition of the site will decline.

3.10 Earlshall Muir

3.10.1 Site description

Earlshall Muir SSSI covers 430 ha and represents the largest remaining tract of non-forested lime-poor sand dunes in south-east Scotland. The site supports examples of dune ridge and dune slack plant communities, and is one of the few remaining examples in Scotland of a dune system exhibiting a complete succession of vegetation, from accreting mobile dunes to birch and alder woodland.

Natural processes continue in the dynamic frontal dune system, leading to accretion of the foreshore. Inland there is still some movement with occasional blowouts. There has been a large reduction in areas of young dune slack as conditions have become more stable. The site also supports an extensive area of dune alder, willow and birch woodland which is now a rare habitat in Britain due to widespread reclamation and afforestation.

The site supports a number of biological features, including wet woodland, breeding bird assemblage and the species considered as part of this study.

3.10.2 Summary of known invertebrate interests

Notified beetle assemblage feature. The following species are the only ones named in site documentation, although wording suggests other beetles have also been found here.

Arena tabida RDB3
This is a very small staphylinid beetle found on coastal sand dunes. This species is usually associated with dung and decaying organic material such as beached seaweed.

Pissodes validirostris RDB3
This is a true weevil whose larvae feed on the pine cones of Scots pine. Although *P. validirostris* is considered a pest in other countries, it is not so in Britain.

3.10.3 Methods

We used two pitfall traps transects to survey for *A. tabida* for two weeks during May 2013. Each transect was placed in sand dunes and near salt marsh habitats on 13 May and collected on 27 May. Upon a second visit on 10 October 2013, bugvac sampling was employed to search the more established dune grassland. Due to the limited amount of Scots pine available on site, despite a nearby plantation, selection of trees for survey was limited. Trees along the rearmost sand dune were beaten and searched for *P. validirostris* on 10 October. Sample locations are shown in Figure 3.20 and are detailed in Table 3.18.

Table 3.18. Sample locations at Earlshall Muir

Grid reference	Sampling method	Location description
NO4965422282	Beating	Dune grassland
NO4961122151	Bugvac	Dune grassland
NO4975222282	Bugvac	Dune grassland
NO4985122304	Bugvac	Dune grassland
NO4991022291	Bugvac	Dune grassland
NO5006423091	Active search	Debris on beach
NO4974722721	Pitfall traps	Marsh
NO4989323042	Pitfall traps	Dune grassland
NO5019622393	Pond dipping	Marsh

3.10.4 Results

Neither species were found. The strandline material lacked a diverse species range, consisting predominantly of gammarids, tachyporinids and *Stenus* spp. However, there are several sources available for a species associated with carrion and decaying organic matter, including seaweed, terrestrial plant material and dead seabirds. Samples taken from sand dunes more thoroughly colonised by flora still did not reveal any specimens of *A. tabida*.

The sparsely distributed Scots pine trees makes it unlikely that *P. validirostris* is present. It was later discovered that the tree from the original record had been removed, as well as other suitable habitats for this species (Adam Garside, pers. comm.) (Figure 3.63). The possibility of *P. validirostris* occurring on site, however, cannot be ruled out as another population may be present in the coniferous plantation adjacent to the site.

We did find the nationally scarce Hydrophilid beetle *Cercyon littoralis* on bugvac (17 at NO5006423091, two at NO4974722721 on 27 May and one at NO4961122151 on 10 October). This species inhabits organic strandline litter near the high-water mark, and so this suggests that the habitat quality remains good and could still support *A. tabida* (Figure 3.64). Furthermore, we also found the stilt bug *Berytinus minor* on a sand dune during bugvac sampling at NO04961122151 on 10 October. This is the first Scottish record for this species.

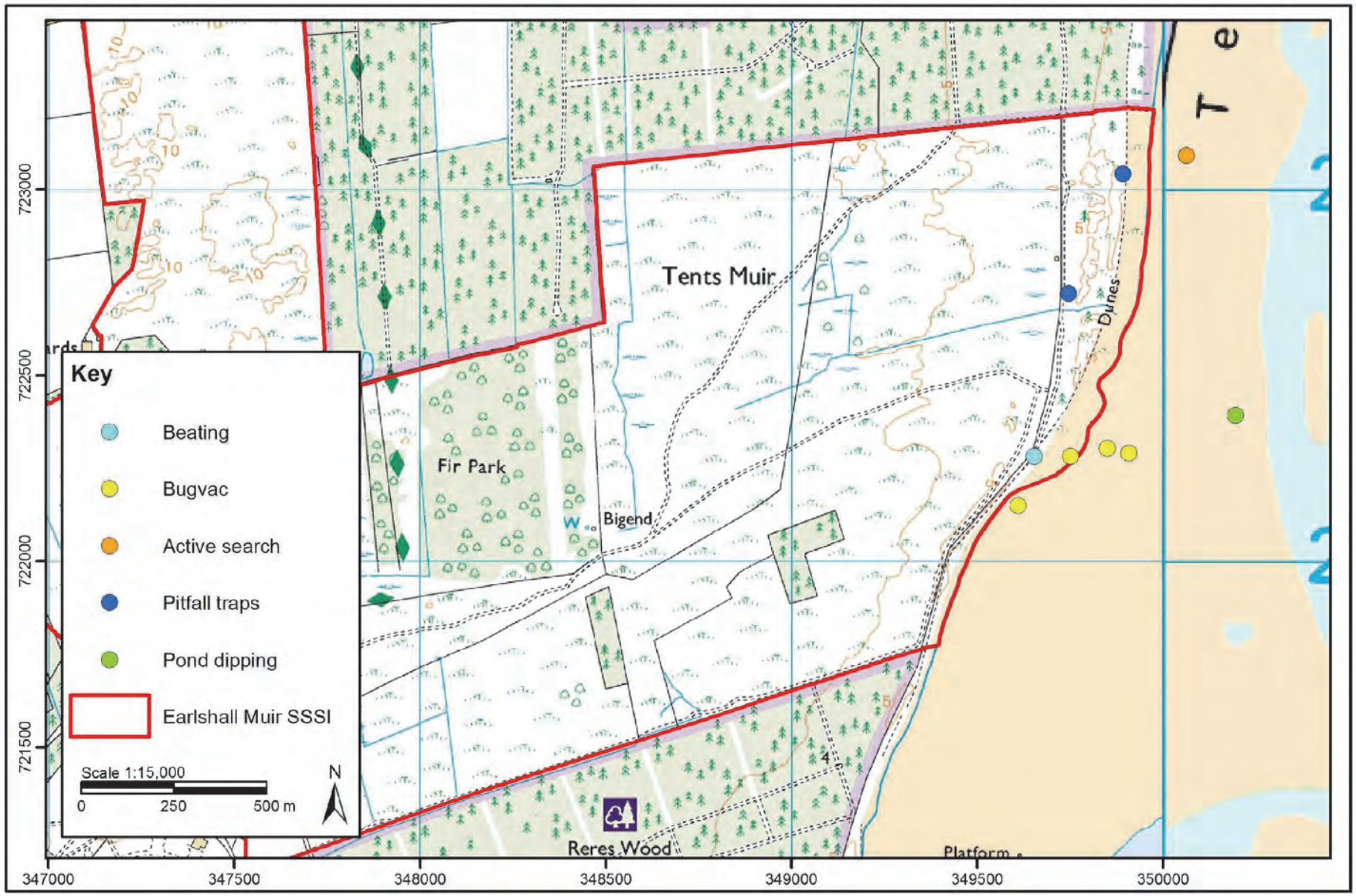

Figure 3.20. Sample locations in Earlshall Muir SSSI

3.10.5 Site condition evaluation

The collection of the nationally scarce beetle *C. littoralis* suggests that the biological strandline litter is of good quality and could support *A. tabida.* The first record of *B. minor* also suggests the site offers good habitat and a warm microclimate.

There was only limited habitat available for *P. validirostris.* While individuals from a population existing in the surrounding plantations of Scots pine may occasionally venture on to the remaining stands on site, it is unlikely that Earlshall Muir could support a sustainable population.

Due to the loss of habitat precluding the existence of a sustainable population of *P. validirostris,* we find the condition of the Coleoptera assemblage feature to be partially destroyed.

3.10.6 Site management recommendations

Earlshall Muir SSSI is a very small site. It is unlikely that replanting trees would provide enough habitat for a sustainable population of *P. validirostris*. The solution most likely to be successful in protecting the local population would be to undertake a survey of the Scots pine plantation that surrounds the site. If this species is found, the site boundary could be extended. No measures are required for *A. tabida*, although it is important to ensure the biological strandline is never lost to beach tidying efforts. Future SCM should include *C. littoralis* in the Coleoptera assemblage.

3.11 Eastern Cairngorms

3.11.1 Site description

Eastern Cairngorms SSSI comprises the two easternmost mountains of the Cairngorm range, Beinn a' Bhuird (1,196 m) and Ben Avon (1,171 m), as well as Glens Lui and Quoich and parts of Glens Luibeg, Avon and Derry. The site ranges from 300 m to 1,196 m in elevation and covers 16,503 ha. The Cairngorms include the greatest extent of high land in Britain, and this, combined with their relatively continental position, creates low winter temperatures, cool summers and a short growing season. As such, the Cairngorms may be regarded, climatically, geologically and biologically as the most extensive arctic-like area in Britain. The site supports a wide range of plant and animal species including many that are rare or scarce nationally.

Eastern Cairngorms includes areas of high plateau, snow-bed habitats, Caledonian forest, mires, grasslands, heathlands, lochs and streams. As the bedrock and associated glacial drift is primarily acidic granite, the vegetation is mainly dominated by acid-tolerant species. The Moine Schist outcrops along the southern and eastern margins of the site however contrast with the granite in providing soils with a higher base-status and fertility. Calcareous habitats and species are very local, most notably on the broken cliffs and in the grasslands and flushes associated with the outcrop of calcareous schist on Craig an Dail Bheag and Slochd Mor.

The site supports a wide variety of biological features, including fungi, lichen, bryophyte and vascular plant assemblages, native pinewood, breeding bird assemblage and Arctic charr (*Salvelinus alpinus*) as well as the invertebrate assemblage.

3.11.2 Summary of known invertebrate interests

This study surveyed the notified invertebrate assemblage feature. This feature includes Hymenoptera (*F. exsecta*) and:

3.11.2.1 *Coleoptera*

Bolitophagus reticulatus RDB3
This is a monophagous tenebrionid that lives in close association with the fungus *Fomes fomentarius* (hoof fungus), where the larvae develop within dead fruiting bodies (Midtgaard *et al.,* 1998). Larvae can live in the fungus for several years and once adult, they chew their way out, leaving conspicuous exit holes. Adults can be found crawling around the exterior of the fungus or on the bark of fungus-ridden trees. *Bolitophagus* is split from other genera of the family by appearing to have four eyes, as a result of the two eyes being completely bisected by the canthus.

3.11.2.2 *Lepidoptera*

Zygaena exulans (scotch burnet) RDB3
Zygaena exulans is a montane moth most often found above 700 m and known only from the Eastern Cairngorms SSSI. The larval food-plant is predominantly crowberry (*Empetrum nigrum*), but also cowberry, blaeberry and other ericoid species (*Calluna vulgaris*, *Erica* spp.). Adults prefer bird's foot trefoil for feeding and fly strongly in sunshine, although they will take cover during bad weather. Adults fly during June and July, and often the hind wings appear translucent in bright sunshine.

3.11.2.3 *Mollusca*

Vertigo geyeri (Geyer's whorl snail) RDB1 Annex II
Vertigo geyeri is a rare and threatened (RDB1) species of whorl snail, about 2 mm in size. It is listed on Annex II of the EU Habitats Directive, requiring the designation of Special Areas of Conservation (SACs) to protect it. Cameron and Killeen (2001) considered it to be declining in the UK. There are few known populations in the Scottish Highlands, and its distribution is not completely known. It is equally rare in the rest of Britain, and Boyce (2002) considered it an "extremely important" indicator of calcareous seepages. Its notification in Eastern Cairngorms reflects a single record from surveys in the late 1990s by Killeen & Colville (1999) who sampled six locations in Glen Lui and its side valley Clais Fhearnaig. They identified a single shell of *V. geyeri* from a wet calcareous stony flush in Glen Lui, and concluded that more work was needed to elucidate what seemed like a sparse occurrence. On the whole, the Eastern Cairngorms is underlain by acid geology, and basic influences at the surface are few and localised. *Vertigo geyeri* requires moderately calcareous wet flushes, and thrives best in strongly-calcareous flushes on other sites in the Deeside area (Killeen & Colville, 1999). It can tolerate all but the most alkaline conditions (Schenková *et al.,* 2012).

3.11.3 Methods

Fieldwork was completed in 2013 and 2014.

3.11.3.1 *Terrestrial invertebrates (excluding* F. exsecta*)*

We undertook targeted searching for *Bolitophagus reticulatus* in Glen Quioch during 2013. The valley of Glen Quioch is covered in open woodland consisting partly of birch on which *F. fomentarius* grows. Trees with *F. fomentarius* at different levels of decay were searched (Table 3.19, Figure 3.21).

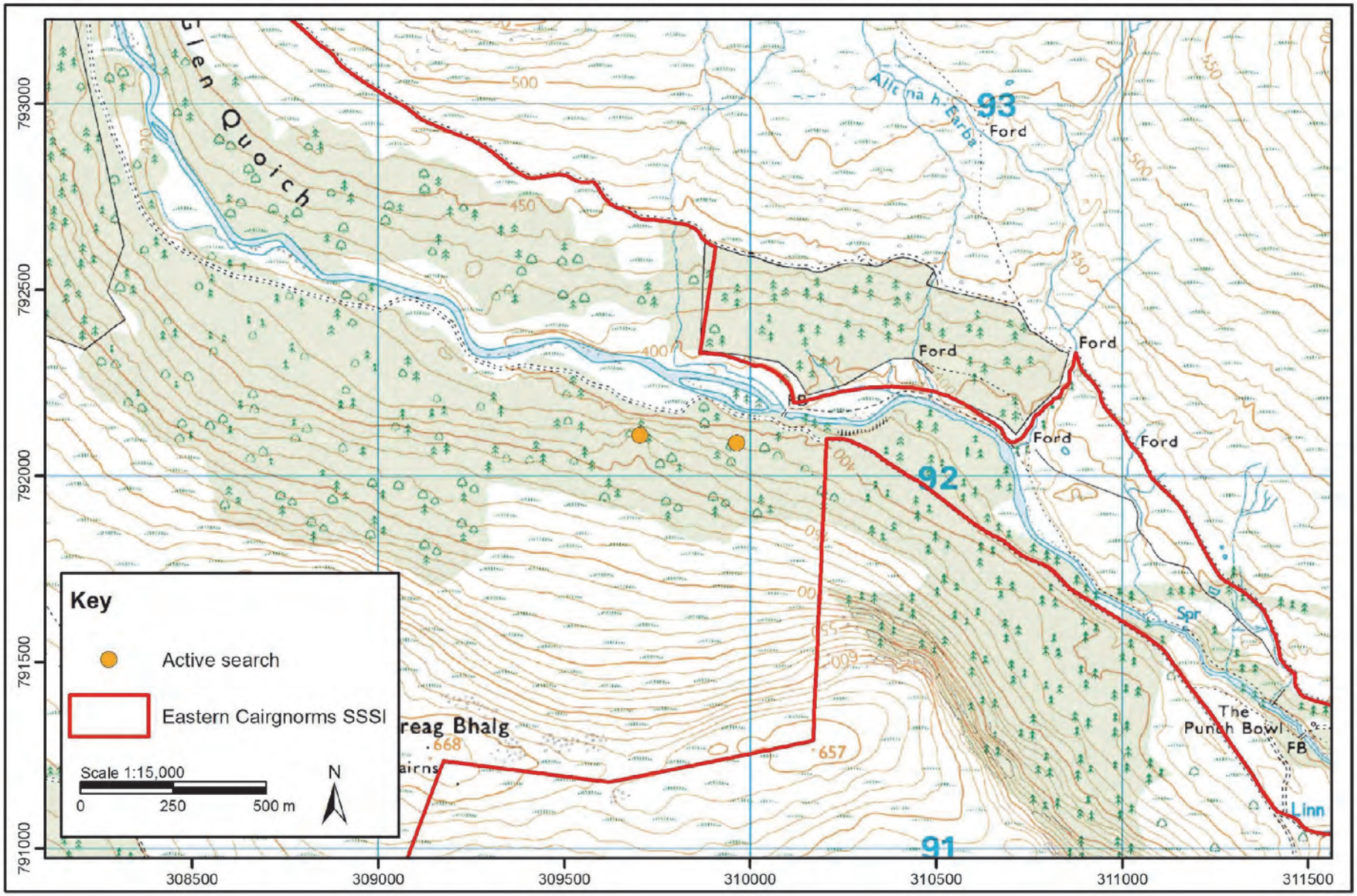

Figure 3.21. Coleoptera sample locations in Eastern Cairngorms SSSI

Table 3.19. Terrestrial invertebrate sample locations at Eastern Cairngorms

Grid reference	Sampling method	Location description
NO0970492110	Active search	Dead birch with *Fomes fomentarius* fruiting bodies
NO0996592089	Active search	Dead birch with *Fomes fomentarius* fruiting bodies

3.11.3.2 *Formica exsecta*

Fieldwork was completed during 2013. Due to the small number of known nests at this site, the survey for *F. exsecta* involved locating each of them by using the most recent available grid references provided by Shaila Rao, National Trust for Scotland (NTS). The habitat surrounding nests was also assessed. We searched for additional colonies in suitable areas surrounding existing nests using fixed transects. The survey was carried out on 3 July (Glen Quoich) and 4 July (Forest of Mar). Survey days were chosen when the weather was dry, warm and sunny, favouring ant activity. Where NTS had assigned a number to a known nest, we have used these in order to maintain consistent record identification. Methods followed those described previously.

3.11.3.3 *Lepidoptera*

We surveyed the Eastern Cairngorms SSSI on 18, 19 and 20 June 2014 concentrating on suitable habitat within the correct elevation for the species. Surveys, where possible, were undertaken in sunshine and low wind amongst areas where larval and adult food plants were available. Aerial netting and sweeping were used to collect adult flying specimens and caterpillars amongst low growing dwarf shrubs. However, high winds and intermittent sunshine limited much of the survey to sheltered areas and assessing the habitat status for *Z. exulans*.

The primary survey areas were within the Invercauld Estate on the hills south of Ben Avon where previous sightings had been recorded (NBN Gateway) (NO9811, NO9911, NO9913, NO9914, NO9814).

Sample locations are shown in Figure 3.22.

3.11.3.4 *Mollusca*

Fieldwork was completed during 2013. Our work concentrated on the Glen Lui flushes surveyed previously by Killeen & Colville (1999), and on additional flushes in Glen Lui (Figures 3.65 and 3.66). We also surveyed Glen Quoich and Gleann an t-Slugain, searching for calcareous flushes, but we did not ascend as high as the calcareous schist of Craig an Dail Bheag, by Ben Avon, which is mentioned in the citation. This area has calcareous grassland and rocky habitats, and could potentially have wet flushes suitable for supporting *V. geyeri.*

In Glen Lui, we searched for calcareous wet stony flushes with calciphile plants (Killeen & Colville, 1999) on 3 and 4 July. We sampled the same flushes as the previous surveyors, as well as some additional flushes. Our samples included short sedges as theirs did, but our processing methods differed: whereas they collected and dried individual sedge plants that may be occupied by *V. geyeri*, we collected 1 L aggregated samples of sedge, moss, herbs, litter and substrate. For larger flushes, we took up to five samples, spread out over a wide area. For some smaller flushes, we took one or two samples.

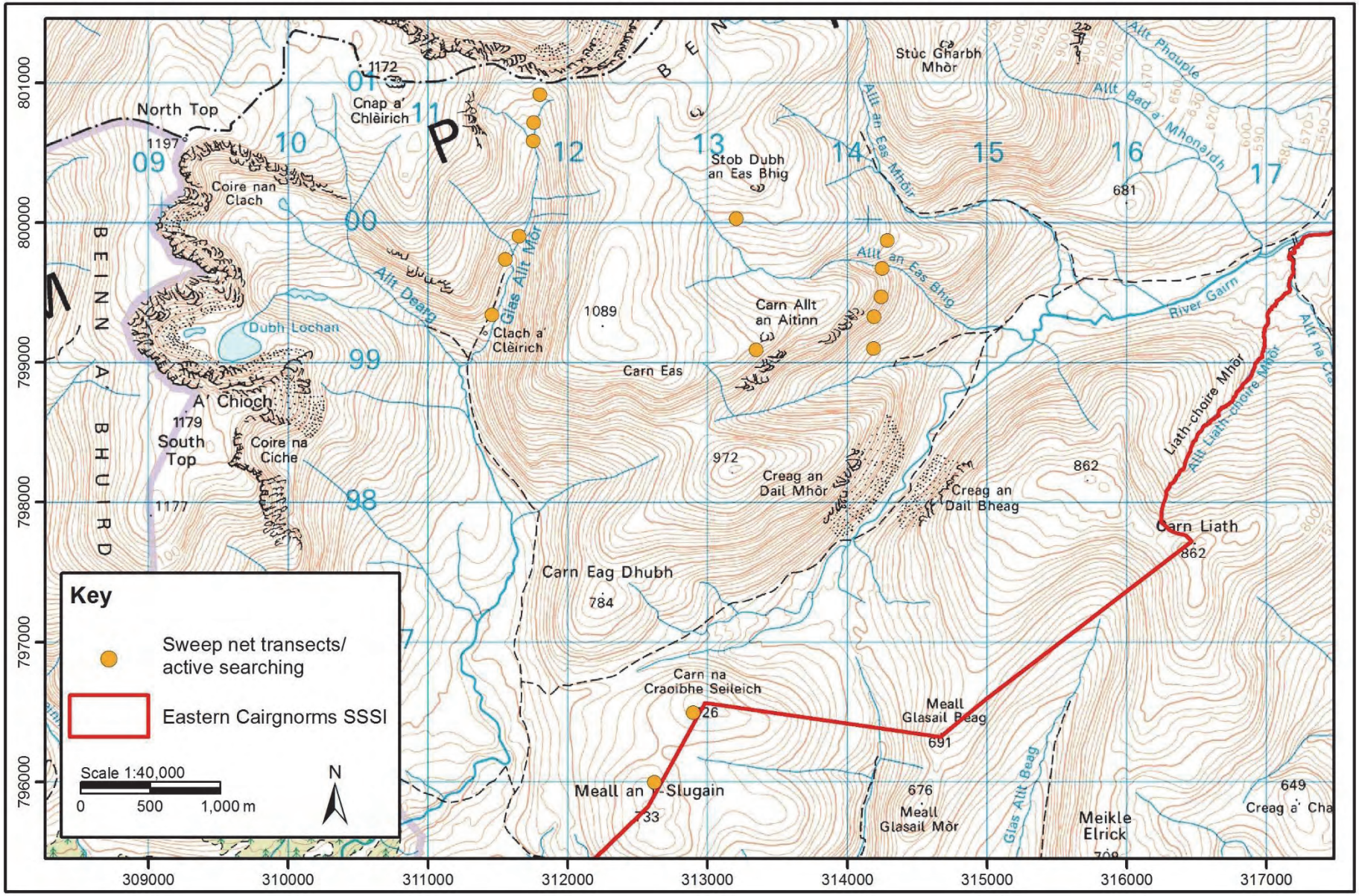

Figure 3.22. Lepidoptera sample locations in Eastern Cairngorms SSSI

We also searched Clais Fhearnaig on 3 July, Glen Quoich on 1 July, and Gleann an t-Slugain on 5 July, but found no calcareous flushes. At some locations in Clais Fhearnaig and Glen Quoich, including limestone and calcareous schist outcrops, we took speculative samples that may yield rare *Vertigo* species or other molluscs. Sample locations are summarised in Table 3.20 and shown in Figures 3.23, 3.24 and 3.25.

Table 3.20. Eastern Cairngorms Mollusca sample locations

Grid ref	Location
NO1094391991	Glen Quoich, west side
NO1087191998	Glen Quoich, west side
NO1051591521	Glen Quoich, west side
NO1054791520	Glen Quoich, west side
NO1121191441	Glen Quoich, west side
NO0646590280	Glen Lui, west side
NO0634790682	Glen Lui, west side
NO0635991520	Glen Lui, east side, old river braid
NO0618291846	Glen Lui, east side, floodplain edge
NO0497592656	Glen Lui, east side, below track
NO0496992651	Glen Lui, east side, below track
NO0496192639	Glen Lui, east side, below track
NO0494592627	Glen Lui, east side, near river
NO0497592596	Glen Lui, east side, near river
NO0497392639	Glen Lui, east side
NO0496492626	Glen Lui, east side
NO0497992626	Glen Lui, east side
NO0589192670	Glen Lui, ravine up to Clais Fhearnaig
NO0622192845	Clais Fhearnaig
NO0652793098	Clais Fhearnaig, north side
NO0685293294	Clais Fhearnaig, north side
NO0709593476	Clais Fhearnaig, north side
NO0477392776	Glen Lui, east side, below track
NO0484492734	Glen Lui, east side, floodplain edge
NO0485192709	Glen Lui, east side, floodplain edge
NO0552992472	Glen Lui, east side, above track

3.11.4 Results

3.11.4.1 *Terrestrial invertebrates (excluding* F. exsecta*)*

A single *B. reticulatus* specimen was collected in open birch woodland at NO0970492110 in Glen Quioch on 2 July. The birch woodland is situated on the west slopes of the valley and becomes increasingly open with elevation. Several trees are dead and have *F. fomentarius* growing from them, providing ample habitat for developing *B. reticulatus* larvae (Figure 3.67). The specimen was found crawling around the outside of a desiccated fungal fruiting body with boring holes from previous animals. The tree to which the fungus was attached was dead; a 2-m trunk was still standing, with the top half lying beside it. The survey was reduced in time due to the continual heavy rain, which may also have had an effect on the activity of *B. reticulatus*.

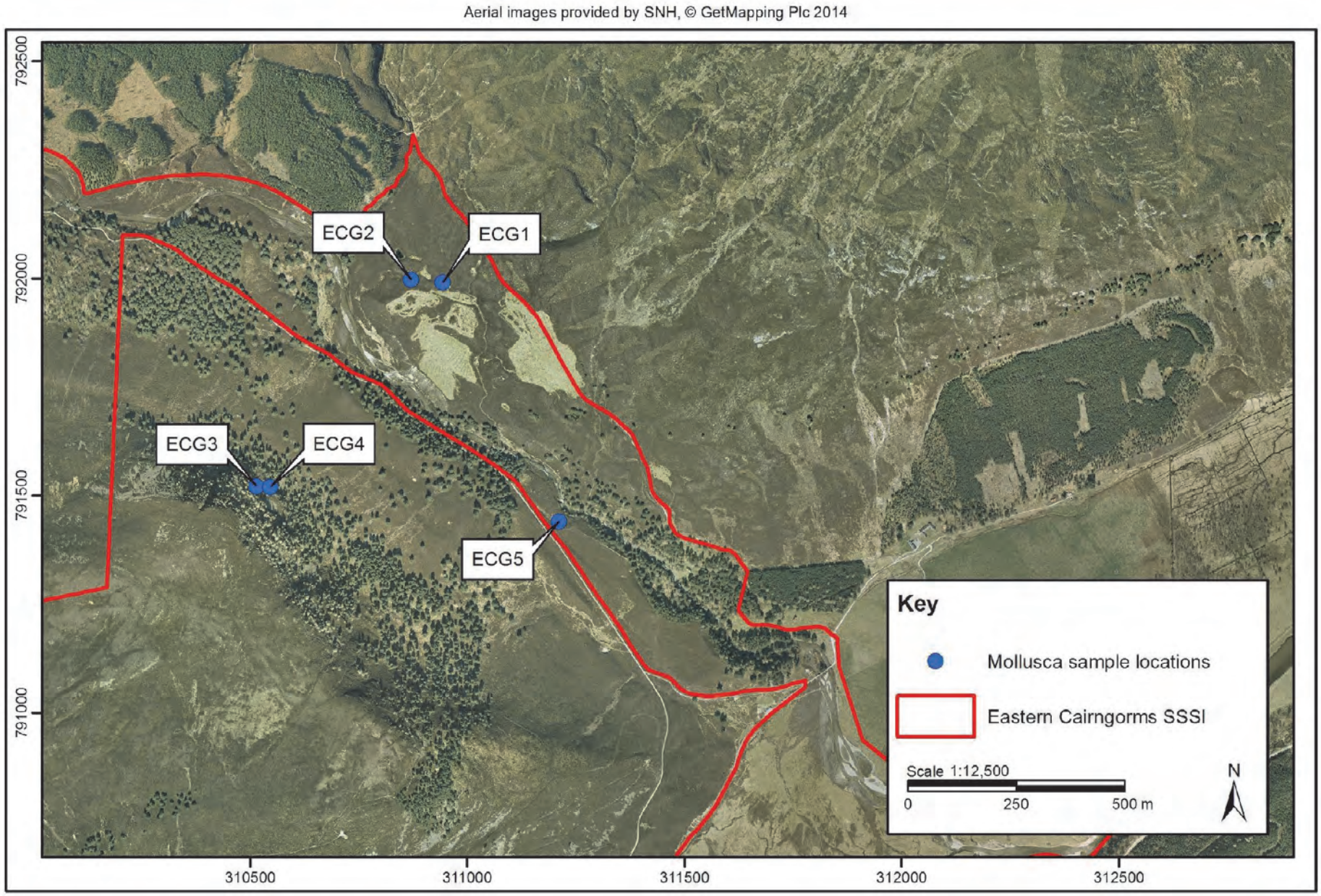

Figure 3.23. Mollusca sample locations in Eastern Cairngorms SSSI: East

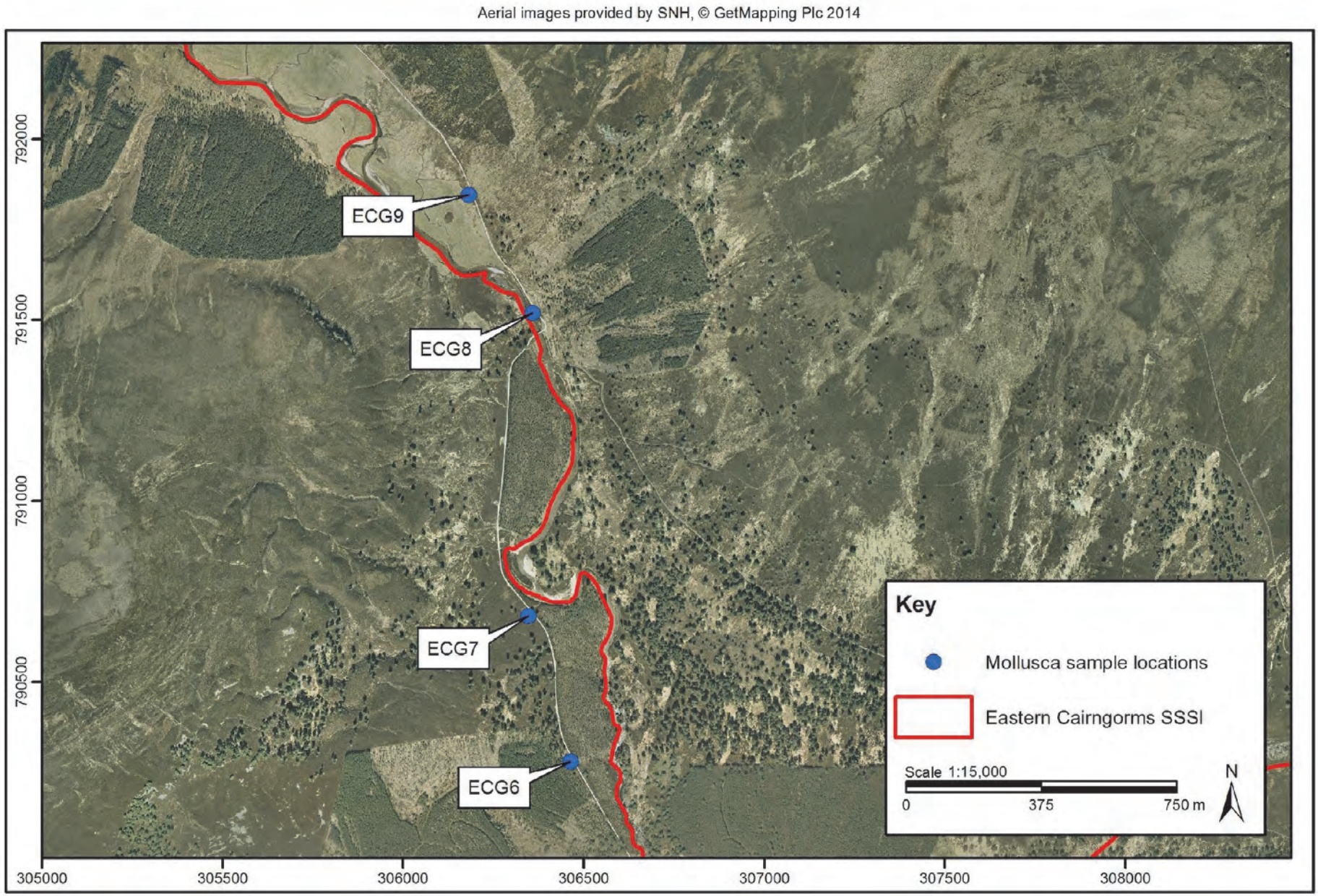

Figure 3.24. Mollusca sample locations in Eastern Cairngorms SSSI: South-west

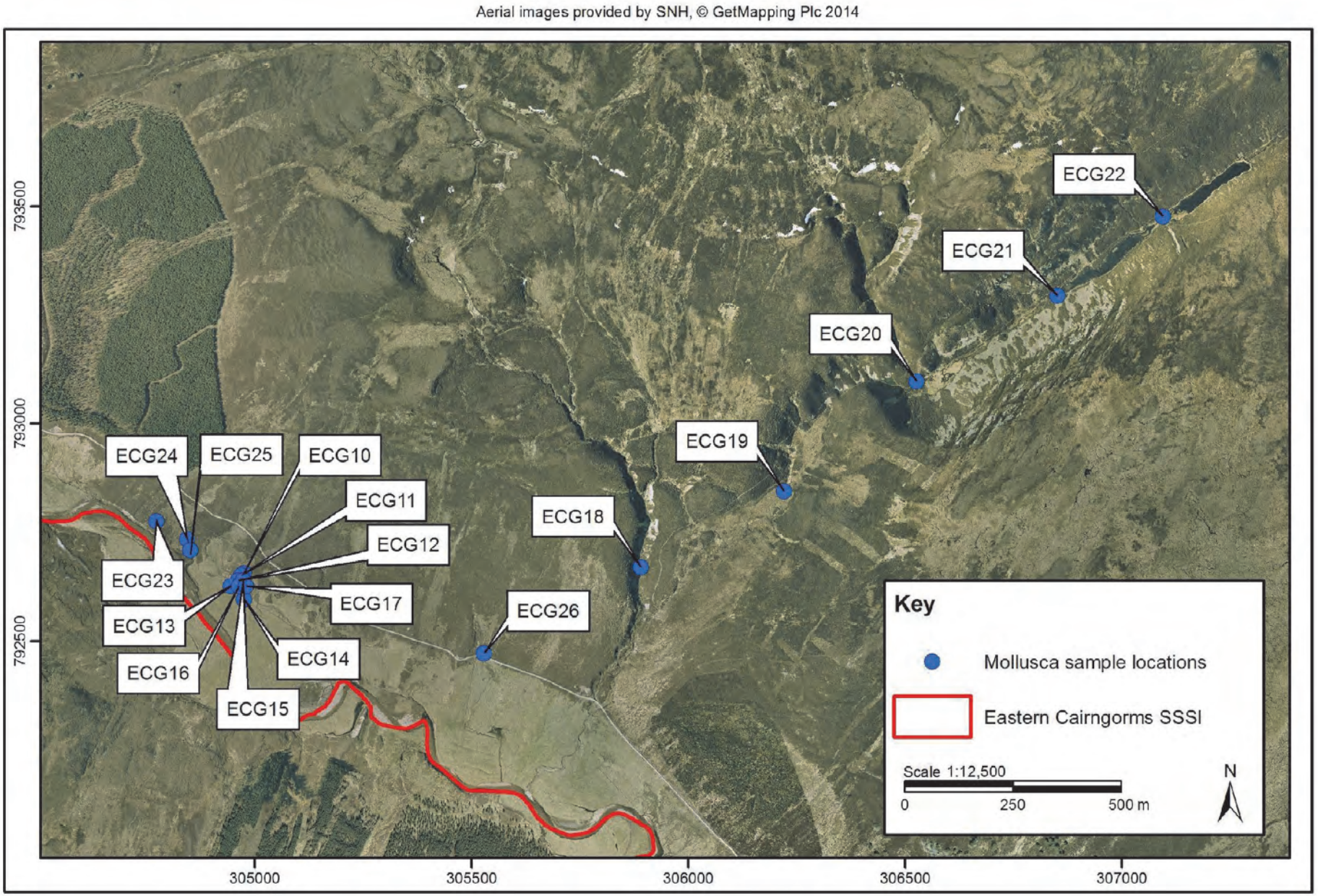

Figure 3.25. Mollusca sample locations in Eastern Cairngorms SSSI: North-west

3.11.4.2 *Formica exsecta*

A total of 16 active *F. exsecta* nests were found on the estate, all known records. These were split between Glen Quoich and the Forest of Mar. A nest in Forest of Mar, last recorded as active in 2012 (Shaila Rao, pers. comm.) was found to have been abandoned. The habitat in some areas of the estate is changing and in time, without intervention, could become unsuitable for this species. None of the nests are deemed to be at risk from human disturbance despite some being located close to public footpaths. *Formica lemani* was found to be common across the survey area and so availability of hosts is not believed to be a limiting factor in the distribution of *F. exsecta* on the estate.

At present, Glen Quoich contains seven active *F. exsecta* nests, five of which are in a cluster on the hillside on the eastern side of the River Quoich (nests 14, 15, 17, 18 and 19). The remaining two are singular, isolated nests on the western side of the River Quoich (nests 8 and 16).

We recorded nine active *F. exsecta* nests in the Forest of Mar. One abandoned nest, judging from photographs and grid references, was considered to be nest 4, which was recorded as active in 2011 (NTS Monitoring Survey, carried out by Hayley Wiswell). The nests were not all in the same area and are separated by a deer fence running north to south. Nest 9 was situated on its own beside the River Lui, outside the fenced area. Nests 5 and 13 lay outside the fenced area but close to the fence-line. The remaining seven nests (1, 2, 3, 4, 10, 11 and 12) lie inside the fenced area (Figure 3.26).

3.11.4.3 *Lepidoptera*

We did not find adult or larval specimens of *Z. exulans* during the 2014 surveys, although suitable habitat was found to be present within the preferred elevation of this species, above 700 m.

Crowberry was found in abundance on well drained slopes and becoming more abundant with increasing elevation. However these areas may be too exposed to suitable to support *Z. exulans* colonies. The more sheltered slopes beneath the plateau have deeper heather cover, limiting crowberry and bearberry. The larval food plants are, however, present from the plateau down to the valley floor at 500 m (Figure 3.68).

The use of the Eastern Cairngorms SSSI for hill-climbing has resulted in a network of paths that offer a different microhabitat to the surrounding heath (Figure 3.69). Well-drained soils adjacent to the paths and a higher exposure to light allow plants such as common bird's-foot trefoil and mountain everlasting (*Antennaria dioica*), otherwise restricted to thin-soiled patches, to flourish, therefore providing adult *Z. exulans* with a plentiful nectar supply.

We did find the nationally scarce *Glacies coracina* (black mountain moth) during surveys (at NJ1175700714 and NJ1180200914), which also uses crowberry as its larval food plant.

3.11.4.4 *Mollusca*

We found molluscs in 18 out of 26 samples, but did not find *V. geyeri.* The only vertiginids were widespread species: *V. substriata* (five samples) and *Columella aspera* (two samples). Cameron & Killeen (2001) considered *V. substriata* to be declining in the UK, but it is not currently considered rare or threatened.

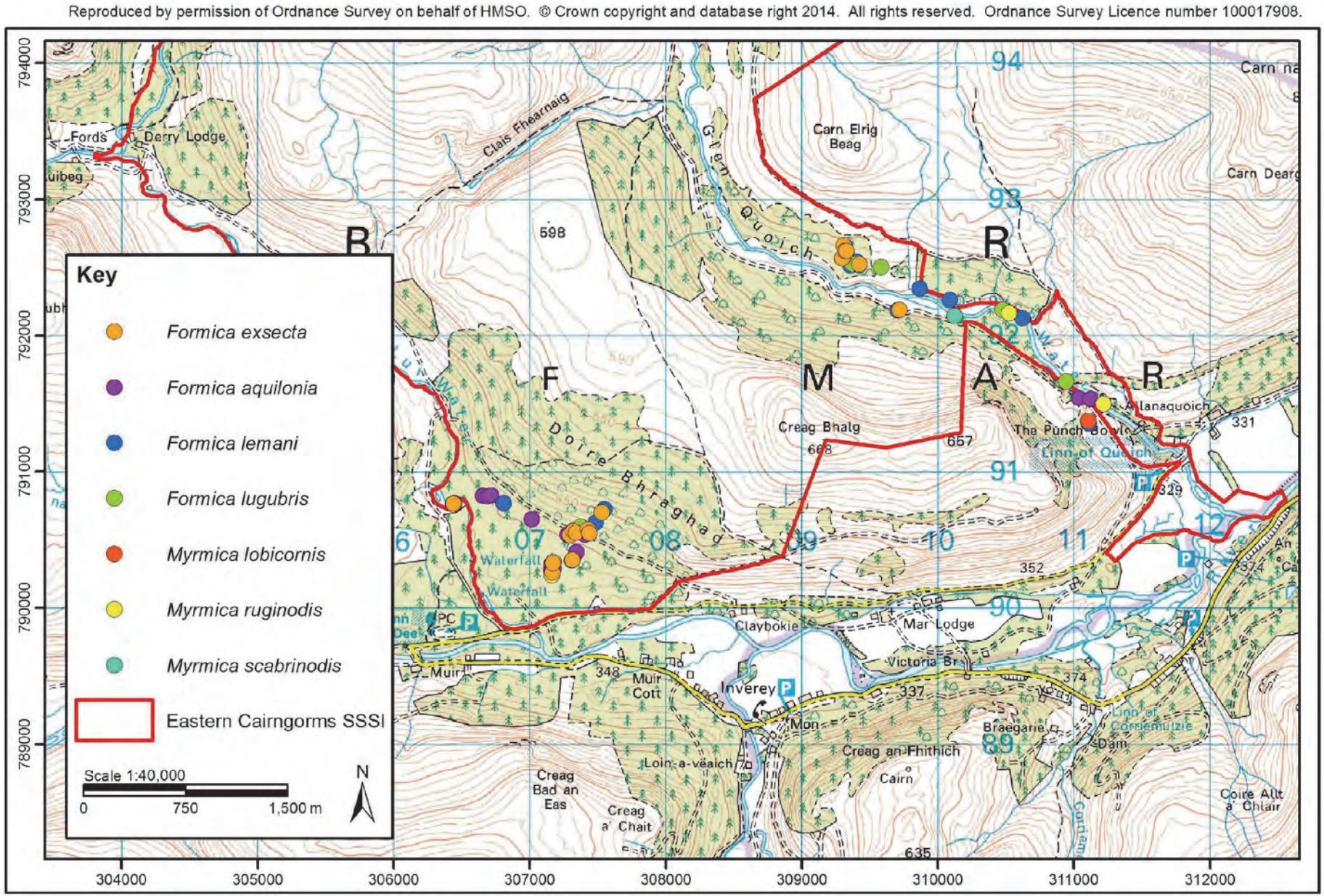

Figure 3.26. Ant nest locations in Eastern Cairngorms SSSI

Molluscan diversity varied greatly between samples, with as few as one and as many as nine species per sample. *Galba truncatula* was the most frequently encountered freshwater mollusc in our samples (13 out of 26). The next most common freshwater species were *Radix balthica* (six samples) and *Pisidium personatum* (five samples). The most widespread land snail was *Nesovitrea hammonis,* which is tolerant of acid substrates (seven samples). The most numerous species was *Carychium minimum,* of which 120 shells were counted from one sample from a floodplain mire below a calcareous flush in Glen Lui.

We recorded *Arion ater* visually in many locations, but generally did not stop to identify smaller slug species. We did not record any unusual or rare species visually, but recorded *Limax cineroniger* (the ash-black slug), which is uncommon, on the south bank of the River Dee to the south of the site. Results are summarised in Table 3.21.

Table 3.21. Eastern Cairngorms Mollusca results

Grid reference	Habitat	Mollusc spp.
NO1094391991	Sedge/moss/rush bog	
NO1087191998	Sedge/moss/rush bog	
NO1051591521	Moss/birch litter, rock face/top of scree	2
NO1054791520	Mossy rock face	4
NO1121191441	Sedge/moss bog	
NO0646590280	Sedge/moss bog	
NO0634790682	Rush/sedge bog	
NO0635991520	Sedge/moss bog	
NO0618291846	Dendritic flush	
NO0497592656	Large wet stony flush	1
NO0496992651	Large wet stony flush	5
NO0496192639	Large wet stony flush	3
NO0494592627	Sedge/moss below flush	9
NO0497592596	Sedge/moss below flush	6
NO0497392639	Wet stony flush	2
NO0496492626	Wet stony flush	6
NO0497992626	Wet stony flush	2
NO0589192670	Moss/litter below schist rock face	1
NO0622192845	Sedge/moss valley mire	3
NO0652793098	Limestone outcrop	7
NO0685293294	Sedge/moss marsh, loch margin	3
NO0709593476	Sedge/mud, rocky loch margin	1
NO0477392776	Dry stony flush, small area wet	
NO0484492734	Wet stony flush (upper part)	3
NO0485192709	Wet stony flush (dendritic lower part)	2
NO0552992472	Wet flush	1

3.11.5 Site condition evaluation

3.11.5.1 *Coleoptera*

The continued presence of *B. reticulatus* was confirmed and had weather conditions been more favourable, we have little doubt that further specimens would have been recovered.

3.11.5.2 *Hymenoptera*

Glen Quoich

The habitat of the eastern hillside Glen Quoich currently offers favourable conditions for *F. exsecta*. Tree regeneration on the eastern side of the river is low and the habitat is subjected to adequate grazing and disturbance to create pockets of sparse, short vegetation necessary for nests to colonise. At present the existing nests are not at risk from shading. Nests 8 and 16 on the western side of the River Quoich are more vulnerable to habitat change due to their isolation from each other (approximately 1.5 km), and also from the other nests in the Glen. The area of nest 16 on the floodplain of the River Quoich is undergoing significant levels of regeneration. If, however, open pockets are maintained, there should be enough habitat for this colony to persist. At Nest 8, heather height is not posing a threat and there is little tree regeneration. As such this nest is not considered to be currently at risk of shading and there is suitable surrounding habitat to allow nest budding to take place.

Forest of Mar

Nest 9 was isolated on the floodplain of the River Lui. The next closest *F. exsecta* nest is approximately 855 m away (nest 5). The isolation means the colony is vulnerable to extinction. The habitat surrounding nest 9 is, however, considered to be good for *F. exsecta*; regeneration is rare to occasional within 30 m of the nest and ground vegetation comprises mosaics of heather and grasses. Nest 5 was found to have re-located and this is most likely to have occurred due to encroachment by tall heather. Nest 13 was found to have re-located in 2011 (NTS Monitoring Surveys) and it was in poor condition and had very low activity (no more than five ants observed) during this study. Other nests existed here in the past but were abandoned in 2007 due to shading (NTS Monitoring Surveys). Habitat at nests 5 and 13 is considered to be average to poor for *F. exsecta.* The height of heather and lack of pockets of short vegetation are threatening and restricting nests (Figure 3.70). As the number and condition of nests in this location has declined since 2007, the habitat appears to become increasingly unsuitable for *F. exsecta*. The heather is taller than knee-height in some areas, and there are considerably fewer patches of moss and short vegetation compared to Glen Quoich.

Formica aquilonia is frequent in this area. Nest 5 is approximately 10 m away from an area of high *F. aquilonia* activity and nest 13 is 20 m away from a medium-large *F. aquilonia* nest. The combination of competition from *F. aquilonia* and shading are likely to be putting increased pressure on the remaining *F. exsecta* colonies.

Nests within the deer fence along the forest track (1, 2, 3, 11 and 12) are in a habitat currently considered unfavourable for *F. exsecta*. Tree regeneration (mostly Scots pine) is abundant around all nests but particularly around those closest to the track (1, 3 and 11) (Figure 3.71). Other wood ants are abundant and are likely to become more dominant as woodland cover increases, forcing *F. exsecta* out of this area.

Nest 10 lies approximately 200 m north of the forest track within the fenced area, on the hillside above nests 1, 2, 3, 4, 11 and 12. The habitat surrounding this nest is dominated by heath with scattered birch. This is a relatively large nest with ants seen scouting around the thatch and up to 15 m away. Tree regeneration in this area is very low compared to that around the other nests within the fenced area. The nest is partially shaded by heather but approximately 70% of the thatch remains open. Heather encroachment could be a problem and could also reduce the availability of mossy and grassy pockets for new nests.

The thatch of nest 4 had collapsed and had not been maintained for some time. *Formica aquilonia* was seen on the thatch and in the immediate area, and competition could be the cause of nest abandonment. *Formica exsecta* may still be present in the area around nest 4

as 5-10 workers were seen on top of a mossy hummock 5 m from the abandoned nest, but no thatch was found.

Three of the *F. exsecta* nests (8, 9, 10 and 16) at the Eastern Cairngorms SSSI are singular, highly isolated colonies. The long-term survival of isolated ant nests is not fully understood, and it is unclear why these nests have not formed satellite nests or formed new colonies in recent years despite suitable surrounding habitat.

3.11.5.3 *Lepidoptera*

Z. exulans was not found during 2014 surveys, although both larval food plants and adult nectar sources were found. Most of the habitat about 700 m elevation is extremely exposed, while more sheltered areas tend to be dominated by deeper heath which limits the availability of larval food plants. Therefore, it is possible that this species persists only in limited areas offering shelter where heather has not excluded larval food plants.

3.11.5.4 *Mollusca*

Despite extensive survey, the status of *V. geyeri* remains unknown on this site. *Vertigo geyeri* is very difficult to detect, and absence would be almost impossible to prove. Populations tend be localised and strongly affected by water levels, distribution of sedge plants, nutrient content, and other microhabitat features (Killeen & Colville, 1999; Boyce, 2002; Schenková *et al.,* 2012).

The strongest constraint on the status of *V. geyeri* in Eastern Cairngorms is the relative scarcity of calcareous flushes. The plutonic geology is generally acid, with localised calcareous influences, few of which are strongly-calcareous. The flushes we surveyed in Glen Lui are lightly calcareous, originating from calcareous schist. Flushes associated with softer limestone bedrock may be preferred by *V. geyeri*. We encountered only one non-metamorphosed limestone outcrop: a small crag beside a burn descending the north slope of Clais Fhearnaig. *Clausilia bidentata* and other terrestrial snails were immediately identifiable, but we found no associated wet flush. Surveys of the higher slopes of the adjacent ravine may reveal *V. geyeri,* or possibly even *V. alpestris*.

It is likely that some calcareous flushes have yet to be surveyed, especially in upper slopes without footpath access. For example, we did not survey the area around Craig an Dail Bheag, at altitudes over 800 m, which the citation describes as supporting a range of calcareous habitats. Survey there would have been speculative, and given the distance and altitude, was outside the scope of this work. Future survey would be worthwhile, to prospect for *V. geyeri* and *V. alpestris,* and potentially even *V. genesii.*

It should also be noted that the preservation of snail shells is poorer in environments only weakly alkaline. Thus the detectability of snails inhabiting weakly-calcareous flushes (and indeed acid substrates) is biased towards recently-dead individuals. This has implications for survey methods and interpretation of findings.

3.11.6 Site management recommendations

3.11.6.1 *Coleoptera*

Any management should aim to ensure the continued availability of *F. fomentarius*.

3.11.6.2 *Hymenoptera*

It is recommended that the current programme of annual nest activity monitoring is continued. It is also recommended to continue monitoring habitat change around nests –

particularly around isolated ones and those along the forest track in Forest of Mar where levels of pine regeneration are high. With regards to isolated nests, close attention should be given to monitoring vegetation. If necessary, these nests should be protected from shading by cutting back vegetation. Habitat within a 10 m radius of each nest should be maintained in a state suitable for the continued support of *F. exsecta*.

The habitat on eastern Glen Quoich should be maintained as open canopy with regeneration maintained at a level that it does not encroach on nests and risk shading. Habitat within the fenced area of the Forest of Mar is currently unfavourable for *F. exsecta* due to the high levels of Scots pine regeneration as a result of lack of grazing. Nests 1, 2, 3, 11 and 12 require careful monitoring and management (removing saplings, vegetation, etc.) to ensure that heather growth and tree regeneration does not shade them. Some regeneration may be permitted around nests (as ants forage on young trees) but trees must be prevented from growing too close to nests (a 5-10 m buffer zone should be established), particularly on the south side of nests where exposure to the sun is essential for insolation. Additionally, patches of open habitat within reach of existing nests (20-30 m) are necessary as corridors. It is believed that queens disperse over the ground, requiring suitable habitat within a short distance of the nest to allow budding and formation of new colonies (Hughes, 2006).

Nests 5 and 13 are also vulnerable due to the tall nature of heath surrounding nests. Trimming heather with a brush cutter to create mosaics of shorter vegetation may allow colonies to expand. Due to the dense population of wood ants in this area, additional habitat is needed for *F. exsecta* to reduce competition.

3.11.6.3 *Lepidoptera*

Control of heather in some sheltered areas so as to encourage growth of crowberry would provide pockets of suitable habitat for *Z. exulans*.

3.11.6.4 *Mollusca*

Killeen & Colville (1999) raised the possibility that some flushes in Glen Lui may have dried up in recent historical times, and that this may have exerted negative pressures on *V. geyeri*. Certainly some flushes were dry, or largely dry during our surveys, but others were wet, and most were large enough to accommodate a range of conditions simultaneously. The presumed association suggested by Killeen & Colville (1999) of *V. geyeri* with sedges (*Schoenus nigricans* and *Carex* spp.) up which they can climb in particularly wet conditions, should offer a degree of plasticity. Until more is known about the distribution and population status of *V. geyeri* (and perhaps other rare *Vertigo* species) in the Eastern Cairngorms, future prospects cannot be robustly determined. It is difficult to envisage specific management prescriptions that would enhance the species' status, but in general any management that protects or enhances calcareous wet flushes would be beneficial.

3.12 Flanders Moss

3.12.1 Site description

Flanders Moss SSSI is a lowland raised bog that lies in the Carse of Stirling. Covering an area of 859 ha, the site holds one of the largest areas of near-natural raised bog in Britain and represents a significant proportion of the European resource. Degraded areas of raised bog on the site also retain significant conservation value and are recovering.

This site is the largest of only a few isolated and protected remnants of a lowland raised mire system in the Carse of Stirling, which was one of the most extensive of its type in Britain historically. Intact lowland examples of raised mire are becoming increasingly rare and are declining globally, making Flanders Moss internationally important.

The range of high quality lowland raised mire habitats supports a rich invertebrate fauna characterised by a distinct lowland element as well as species more characteristic of northern regions. The site is notified for the spider *Heliophanus dampfi,* as well as its moth assemblage (not included in this study).

3.12.2 Summary of known invertebrate interests

Notified spider feature.

Heliophanus dampfi (bog sun-jumper) RDBK
Until 2011, *H. dampfi* (bog sun-jumper) was known in the UK from two locations in Scotland (Ochtertyre Moss SSSI and Flanders Moss SSSI) and one in Wales. *Heliophanus dampfi* is found only on raised bogs throughout its European range, and prefers *Molinia* and *Eriophorum* microhabitats on the continent (Bratton, 1991; Harvey *et al.,* 2002). In Wales, the species has been found by pitfall trapping in dense *Myrica gale*, *Erica tetralix* and *Eriophorum* spp. vegetation, while in Scotland specimens have been collected by sweeping taller vegetation, such as young Scots pine and birch. Adult females are found between April and July, while males are found between June and July.

In 2011, three new *H. dampfi* sites were found in Scotland: Wester Moss (NS837910), Dunmore Moss (NS869891) and Letham Moss (NS881854). Specimens at Western Moss were collected by Daisy Shepperd and David Pryce, while specimens at Dunmore Moss and Letham Moss were collected by David Pryce and later identified by Cathrine (2012). All specimens were collected by bugvac from the bases of *Molinia* and *Eriophorum* tussocks.

3.12.3 Methods

While pitfall traps were found to be an effective method of collecting *H. dampfi* in Wales, sweeping vegetation (particularly birch regeneration) has proven more effective in Scotland (Harvey *et al.,* 2002). Recent work has however shown that bugvac sampling is more effective in Scotland than either of these methods, and proved successful at Ochtertyre Moss SSSI during SCM surveys in 2011 (Cathrine, 2012). We therefore used a combination of these methods.

We made two visits to Flanders Moss in search of *H. dampfi* during 2013. The first was made on 8 July when pitfall traps were set, and these were collected on 22 July. Three transects of five pitfall traps each were installed on 8 July and collected on 22 July. These were scattered throughout the site, and served as sample sites for the other survey methods. Bugvac samples were taken in the areas surrounding the pitfall trap transects on 8 July, on spots of differing vegetation and water level. Sweep net transects were also completed in these areas (Table 3.22, Figure 3.27).

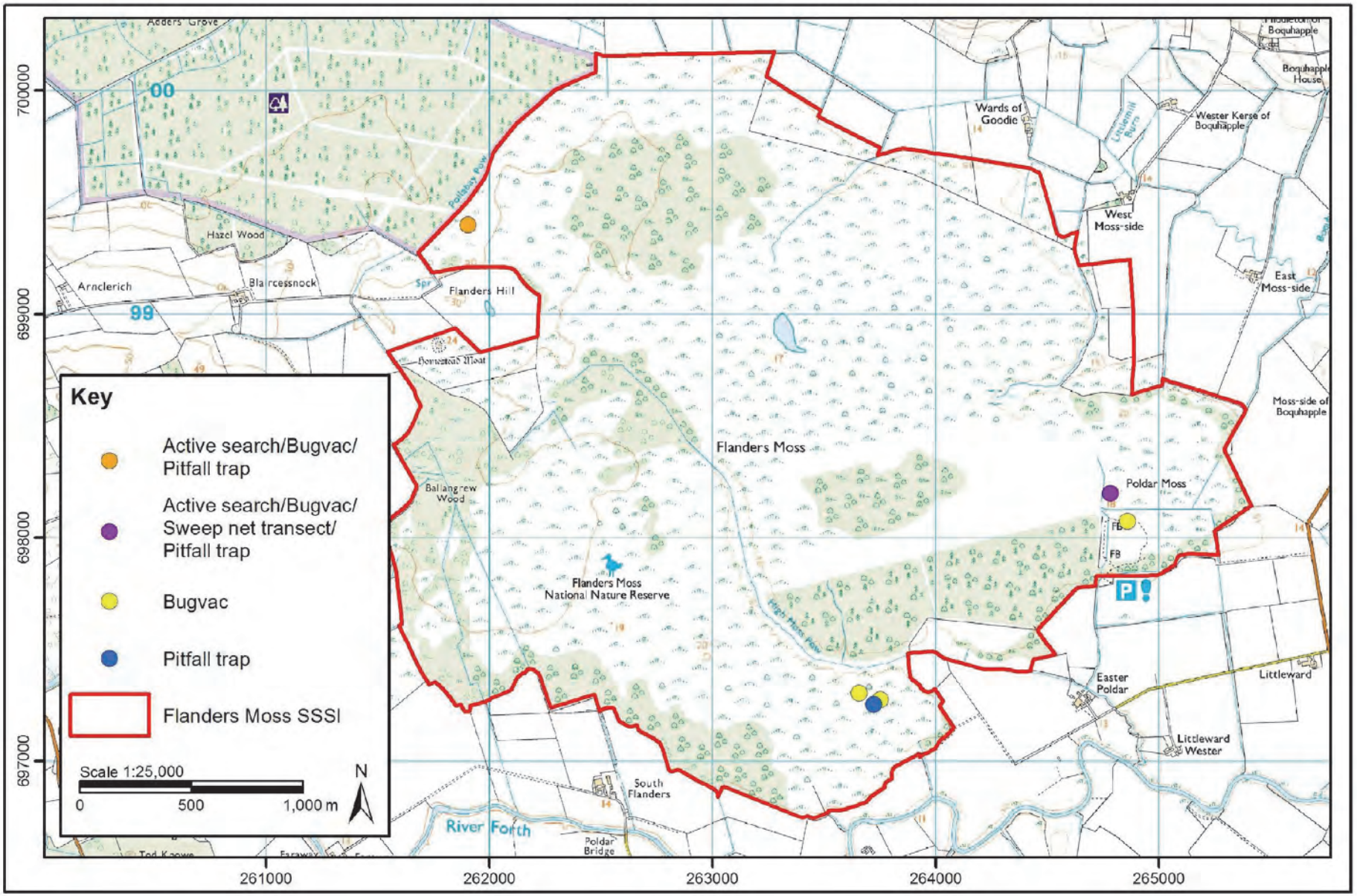

Figure 3.27. Sample locations in Flanders Moss SSSI

Table 3.22. Sample locations at Flanders Moss

Grid reference	Sampling method	Location description
NS6478598198	Active search	Lowland raised bog with birch scrub
NS6190699398	Active search	Lowland raised bog with birch scrub
NS6478598198	Bugvac	Lowland raised bog with birch scrub
NS6190699398	Bugvac	Lowland raised bog with birch scrub
NS6365997306	Bugvac	Lowland raised bog
NS6375397275	Bugvac	Lowland raised bog with birch scrub
NS6486298075	Bugvac	Lowland raised bog
NS6372497255	Pitfall Trap	Lowland raised bog
NS6479098206	Pitfall Trap	Lowland raised bog with birch scrub
NS6190699398	Pitfall Trap	Lowland raised bog with birch scrub
NS6478598198	Sweep net transect	Lowland raised bog with birch scrub

3.12.4 Results

The most speciose groups collected at Flanders Moss were spiders and beetles, which yielded 35 and 16 species respectively, despite our limited targeted survey. *Heliophanus dampfi* was found in all survey areas. Bugvac proved to be the most effective survey method, with *H. dampfi* found in four out of five samples. An individual male was collected on a sweep net sample, and none in pitfall traps.

Almost all *H. dampfi* specimens collected in 2011 and during our surveys were found within *Molinia* and *Eriophorum* tussocks. This suggests that *H. dampfi* has similar habitat preferences in Scotland as it does in Europe. This seems to disagree with the findings of Stewart (1993), who suggested that Scottish populations had an unusual habitat preference for taller vegetation such as birch scrub. Given the relatively small number of specimens collected from Scotland, however, it is possible that this represents random chance or a bias due to collection techniques. For instance, *H. dampfi* specimens located on taller vegetation will be more obvious to surveyors, and more easily accessible to traditional collection techniques. The bugvac collection technique, however, allows surveyors to access microhabitats that cannot readily be sampled, and the results have suggested that *H. dampfi* does seem to be found more often on *Molinia* and *Eriophorum* tussocks than other habitats in Scotland.

Flanders Moss is a large expanse of raised bog and as such the quality of its habitat does vary. These variations are represented in the locations chosen for pitfall traps and bugvac sampling. Two male *H. dampfi* were found in the east of the reserve, 100 m north of the boardwalk beyond a patch of birch scrub (NS6478598198). The bog condition in this area is good and shows no signs of drying out, although there is encroachment from the nearby birch scrub (Figure 3.72). One male was collected from moss hummocks and *Eriophorum* spp. tussocks, while the other was swept from young birch saplings.

We collected four females when bugvac sampling the *Eriophorum* spp. tussocks and moss hummocks in the south of the site where the habitat was slightly drier and suffered from encroachment of birch saplings (NS6375397275).

North-west of the previous sample location by about 100 m was a very dry area of bog with a much higher proportion of bare peat at the surface (Figure 3.73). We collected five females and one male here using the bugvac (NS6365997306).

The final bugvac sampling location was in the north-west of the site. This area is drier than the others with more ericoid shrubs dominating rather than *Eriophorum* spp. At the site boundary, willow is beginning to encroach on the bog causing areas to dry out and allowing plants less water tolerant to colonise (Figure 3.74). Regardless of this apparent change in microhabitat, *H. dampfi* was still found (one male and nine females) (NS6190599392).

We also found a single male specimen of the nationally scarce spider *Araneus alsine* (strawberry orbweaver), which has only been recorded from the south of England and recently Perthshire and Inverness-shire. This spider was collected by bugvac on 8 July at NS6478598198, an area of raised bog with slight encroachment from shrubs and birch regeneration. This location is consistent with habitat where *A. alsine* was recorded in Inverness-shire (Bowman, 2010).

In addition, we collected a single specimen of the nationally scarce ground beetle *Agonum ericeti* in a pitfall trap transect at NS6372497255 on 22 July. This beetle is found in bogs and wet heaths, where it is generally scarce (Luff, 2007).

3.12.5 Site condition evaluation

Heliophanus dampfi was found in good numbers throughout Flanders Moss. This site represents the largest population in terms of extent and apparent density in Scotland, and perhaps the UK.

There is a popular belief that the lowland raised bogs in Stirlingshire were once part of a "super bog". There is no evidence that it ever existed, although historic maps do indicate that the lowland raised bogs were once larger in extent than they are today, offering a greater supply of suitable habitat for *H. dampfi* (Cathrine, 2012). Furthermore, land use between bogs has also changed and became less permeable to dispersing invertebrates in modern times. *Heliophanus dampfi* is threatened by habitat loss, and fragmentation prevents gene flow between isolated populations. Land use between bogs may be a barrier to *H. dampfi* recolonizing otherwise suitable habitat fragments. Despite surveying potentially suitable sites elsewhere in 2011, David Pryce only collected *H. dampfi* from bogs in the Stirling area. This suggests that its distribution is genuinely restricted to Stirling in Scotland. Although Flanders Moss is a relatively extensive lowland raised bog, the other sites in which *H. dampfi* is found are more limited in extent, and some offer only tiny fragments of suitable habitat.

3.12.6 Site management recommendations

Management at Flanders Moss should continue to aim to restore the bog's water table. Our results suggest that *H. dampfi* lives within the bases of tussocks in the bog, and hunts on more open areas of sphagnum. Birch regeneration does not appear to be a major habitat requirement based on our observations during surveys at Flanders Moss and Ochtertyre Moss. Until more thorough research is undertaken, however, we would recommend taking a precautionary approach and ensuring a small degree of young birch regeneration at limited locations. These areas could be rotated to prevent birch becoming established in any location.

Flanders Moss is relatively extensive and supports a sustainable population of *H. dampfi*, while the other sites (Ochtertyre Moss, Wester Moss, Dunmore Moss and Letham Moss) are more fragmentary, and populations are vulnerable to local extinction. This is particularly a threat at Letham Moss where active peat cutting continues and at Dunmore Moss, where peat has been extensively cut over in the past. It is likely that this spider was previously more widely distributed in Stirling, existing on other raised bog fragments and was able to disperse. Land use change and loss of habitat has likely reduced the ability of this spider to

recolonize sites. Consideration should therefore be given to reintroducing *H. dampfi* to other suitable sites in Stirling, so as to limit its vulnerability to loss of local populations.

A speculative invertebrate survey of Flanders Moss SSSI is likely to reveal other species of conservation importance, based on the results of our limited survey in 2013. We therefore would recommend that future surveys consider other Araneae and Coleoptera, including the two nationally scarce species discovered during our surveys.

3.13 Glenmore Forest

3.13.1 Site description

Glenmore Forest SSSI lies on the north-west slopes of Cairn Gorm (1,440 ha) and has an area of Caledonian forest habitat. The forest is an important component in a chain of woodland stretching from Glen Feshie to Abernethy, which forms the largest expanse of native pinewood remaining in the UK. Although much of the native forest was felled in the 19th and 20th centuries, substantial areas of semi-natural woodland have survived. Around 400 ha of the site is self-sown native pinewood, and a similar area has been planted with Scots pine of local origin which is now being managed for conservation. Small areas of juniper and woodland bog are also present. The woodland in lower areas is expanding to areas of open heath, whilst a natural tree line is developing at higher elevations.

The site supports a number of biological features, including vascular plant assemblage, native pinewood, capercaillie, Scottish crossbill and *F. exsecta,* which was monitored in this study.

3.13.2 Summary of known invertebrate interests

This study surveyed the notified narrow-headed ant (*F. exsecta*) feature.

F. exsecta has been recorded in the Glenmore area since the early 1900s (Yarrow, 1954). The most extensive survey for this species at Glenmore Forest was conducted in the late 1990s by Gus Jones, and involved marking the location of individual nests with wooden markers with metal number tags: many markers still persist. Surveys have been repeated more or less regularly since then but have generally focused on sub-samples of the population. The ant is recorded as being widespread throughout the site (Jones, 2009).

The most recent survey by Alba Ecology in 2012 focused on a particular cluster of nests at Badaguish, singled out as a “Conservation Zone” within the forest – this is believed to be the only area of forest monitored and managed specifically for *F. exsecta* by Forestry Commission Scotland (Colin Leslie, pers. comm.).

3.13.3 Methods

It was not logistically practical to survey the entire SSSI, therefore eight 1 km squares where *F. exsecta* had been previously recorded were chosen. The survey was carried out on 21, 29 and 30 August 2013 on dry, sunny days when the ants are active. The survey methods followed those described previously.

3.13.4 Results

Formica exsecta was recorded in all 1 km squares (Figure 3.28), and each is discussed separately.

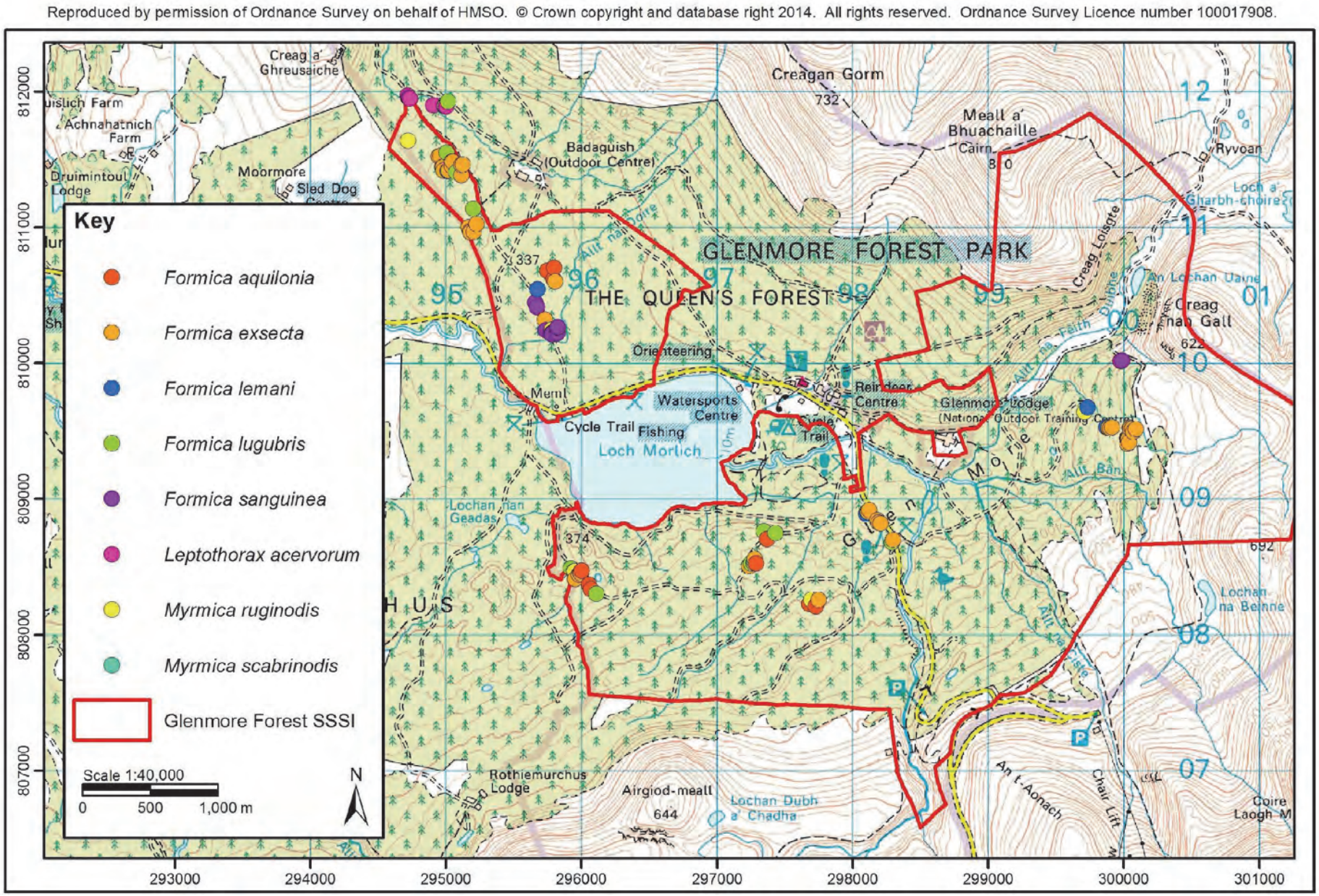

Figure 3.28. Ant nest locations in Glenmore Forest SSSI

NH9708 – south-east of Loch Morlich: the forest structure was mixed and included dense mature Scots pine plantation, areas of younger Scots pine forest, patches of regeneration and ancient Scots pine forest with glades. The wooden posts marking were useful for locating nests or highlighting areas where nests had previously been recorded. Four active nests were found, although many posts were found without nests, suggesting some have been lost or re-located. *Formica aquilonia* was common in some areas, with some large nests present.

NH9808 – footpath adjacent to main road leading to Cairngorm Mountain: we found seven active nests along the footpath adjacent to the main road, north of the area known as the "Hayfield" (Figure 3.75). The nests appeared to be in good condition, and nest building was observed at the time of survey. The nests did not appear to have been disturbed by human activity.

NH9909 and NJ0009 – above Ryvoan: this has been previously marked as a suitable area for *F. exsecta* owing to the presence of several wooden posts. The habitat comprises Caledonian woodland and is variable in structure, containing areas of stunted trees on boggy ground and open sunny glades amongst mature Scots pine. A total of 19 active *F. exsecta* nests were found between NJ9909 and NJ0009 in areas previously marked (Figure 3.76). Not all nests were, however, found immediately adjacent to posts, suggesting new or re-located colonies.

NH9511 and NH9411 – Glenmore Conservation Zone (Badaguish): this area consists of boggy Scots pine woodland where trees are stunted and therefore maintain an open canopy. Although bog is considered suboptimal, this is likely to be the best available habitat for the ants in the area, being surrounded by unsuitable mature woodland and plantation (Hughes, 2006). Thirteen active nests were found in the Conservation Zone along transects, although more are believed to exist. Three active *F. exsecta* nests were at the eastern edge of a telegraph way leave, south of the Badaguish Outdoor Centre. This area was boggy underfoot and with only scattered trees. We located one *F. exsecta* nest beside the Allt Feithe Moire burn in NH9411. Previous records by the burn could not be found despite the habitat being considered suitable. We located four active *F. sanguinea* nests along the main forest track in NH9411. These were situated in old, dry stumps in an area of clear-fell (Figure 3.77).

NH9510 – North of Loch Morlich, east of Badaguish: an area of Caledonian pinewood where *F. exsecta* had been recorded previously. The ground was wet underfoot, causing the trees to appear stunted compared to surrounding forest. The trees were of a similar age class and regeneration was occasional to rare (more frequent beside the forest track). Juniper was common in the understory. The habitat was difficult to survey due to the nature of vegetation and topography. Only two active *F. exsecta* nests were found, both believed to be recorded previously.

NH9508 – South Morlich: a cluster of nests was last surveyed in this area in 2010 (Gallagher, 2010), which is approximately 500 m south of Loch Morlich and close to the boundary with Rothiemurchus. *Formica exsecta* nests had been marked along the forest track, but the only active ones found belonged to *F. aquilonia* and *F. lugubris*. Dense plantation exists on either side of the forest track. We found four active *F. exsecta* nests on the south side of the forest track adjacent to wooden marker posts. These nests were situated in a tree opening that led into an area of bog woodland with an open canopy. Two of these nests were situated within the bog woodland.

3.13.5 Site condition evaluation

Habitat is favourable at present but some areas are undergoing change. There is also evidence to suggest that in some areas the population has declined. This appears to be the case in NH9708, NH9510 and NH9508 in particular, where a greater number of nests had been recorded during previous studies. The densest populations appear to be within the Conservation Zone at Badaguish and in NH9909 and NJ0009 above Ryvoan.

3.13.6 Site management recommendations

A more comprehensive survey of *F. exsecta* in this SSSI is strongly recommended in order to establish how much the population may have changed since the last extensive nest search (possibly late 1990s by Gus Jones). It is likely that many of the existing records are out of date and the present survey certainly indicates that colonies have moved or were abandoned altogether. It is important to maintain an open canopy around existing colonies and corridors of suitable habitat to allow them to spread.

Micro-management may be needed to ensure the longevity of *F. exsecta* in the forest. Although their colonies can adapt to changing conditions in a relatively short time by budding (judging from relocation of nests at Mar Lodge, which occurred within 12 months), regular monitoring will be needed to establish if habitat management is successful. Such micro-management could take the form of localised removal of regenerating Scots pine or trimming heather to maintain a mosaic of height in ground vegetation (where heather is particularly rank or uniform).

As is also the case in Abernethy Forest, it is likely that bog woodland habitat provides *F. exsecta* with a refuge from habitat change and competition from other wood ants. These areas should be maintained, but opportunities for *F. exsecta* to move into drier habitats should be encouraged, for example by creating clearings by selective thinning or trimming.

The area above Ryvoan within NH9909 and NJ0009 is a good example of habitat that can benefit *F. exsecta* and other wood ants – mature woodland with pockets of bog woodland and open glades and rides while tree regeneration is patchy and maintained at a level that does not lead to rapid canopy closure. This heterogeneous habitat will also benefit a wide variety of other woodland taxa including birds such as capercaillie and black grouse.

3.14 Lismore Lochs

3.14.1 Site description

Lismore Lochs SSSI includes three freshwater lochs (Fiart, Kilcheran and Baile a' Ghobhainn) covering 108 ha on the island of Lismore. The site supports habitat features including base-rich lochs and open water transition fen. The base-rich lochs are one of the few high quality examples of this habitat in Scotland. The lochs have very clear water and are low in nutrients but with high alkalinity, which supports several rare stoneworts. The lochs become shallow at each end and in these areas there is a landward transition from aquatic communities to emergent vegetation, with a range of fen communities including reed-bed, sedge swamps and brown moss-mires. The terrestrial habitat supports a regionally-important population of marsh fritillary butterfly, and the lochs and associated fens also support other invertebrates.

3.14.2 Summary of known invertebrate interests

This study surveyed the notified invertebrate assemblage feature.

Coleoptera: *D. aquatica* and Lepidoptera: *Euphydryas aurinia* (marsh fritillary), Annex II. The fritillary is declining across Europe and is a European Habitats Directive Annex II species. In Scotland, the species is mainly associated with damp, open, sunny grasslands, preferably with some shelter, containing the larval food plant devil's bit scabious (*Succisa pratensis*). The adults are on the wing from late May to early July. Females lay clusters of eggs on the underside of leaves of *S. pratensis*, and the larvae live in communal larval webs until late April, when they disperse to pupate. Colonies fluctuate greatly due to brood parasitism by the wasp *Cotesia melitaearum.*

3.14.3 Methods

Fieldwork was completed during 2013.

Searches for *D. aquatica* at Lismore Lochs were carried out on 16 and 17 June. Sedges and rushes growing around Loch Baile Ghobhain, Loch Kilcheran and Loch Fiart were sampled by sweep net transects as described previously (Figure 3.29).

The *E. aurinia* communal larval webs are most easily found by searching the site for areas of breeding habitat in August/September when the food plant is in flower, although they can also be found in early spring (April/early May). During survey visits to Lismore Lochs, adult *E. aurinia* and suitable breeding habitat were recorded at each of the three lochs.

3.14.4 Results

Adult *D. aquatica* were recorded at each of the three lochs. On 16 June, a series of sweep net transects around Loch Fiart recorded *D. aquatica* within sedges and emergent vegetation at the south-west end (NM 80423727 – Figure 3.78) and around an inlet in the north-east of the loch (NM 81183777). Suitable emergent vegetation habitat for *D. aquatica* was very sparse around the north-west side of Loch Fiart. Adult *D. aquatica* were recorded on 17 June during sweep net transects around the south end of Loch Baile Ghobhain (Figure 3.79) and along the south and west shores of Loch Kilcheran (Figure 3.80).

On 16 June, rosettes of the larval food plant *S. pratensis* were observed to be widespread along the steep slopes and the shore on the western side of Loch Fiart (Figures 3.81 to 3.84). Adult *E. aurinia* were recorded along the south western shore of Loch Fiart and seen basking on bog bean (*Menyanthes trifoliata*) and other emergent vegetation in the shallows in the south end of the loch. On 17 June, adult *E. aurinia* were recorded along the western side of Loch Kilcheran and Loch Baile Ghobhain. The larval food plant was abundant along the western side of Loch Kilcheran and the south-western end of Loch Baile Ghobhain.

The nationally scarce narrow-bordered bee hawkmoth *Hemaris tityus* (Family Sphingindae) was also recorded at Loch Kilcheran. The larval food plant of this day-flying moth is *S. pratensis.*

3.14.5 Site condition evaluation

Suitable habitat for *D. aquatica* was present at the southern end of Loch Fiart, and around an inlet in the north-east of the loch (Figure 3.85). Suitable habitat was also present around the southern and western side of Loch Kilcheran, and the southern and north-eastern end of Loch Baile Gobhainn (although no *D. aquatica* were found in the emergent vegetation in the north of Loch Baile Gobhainn).

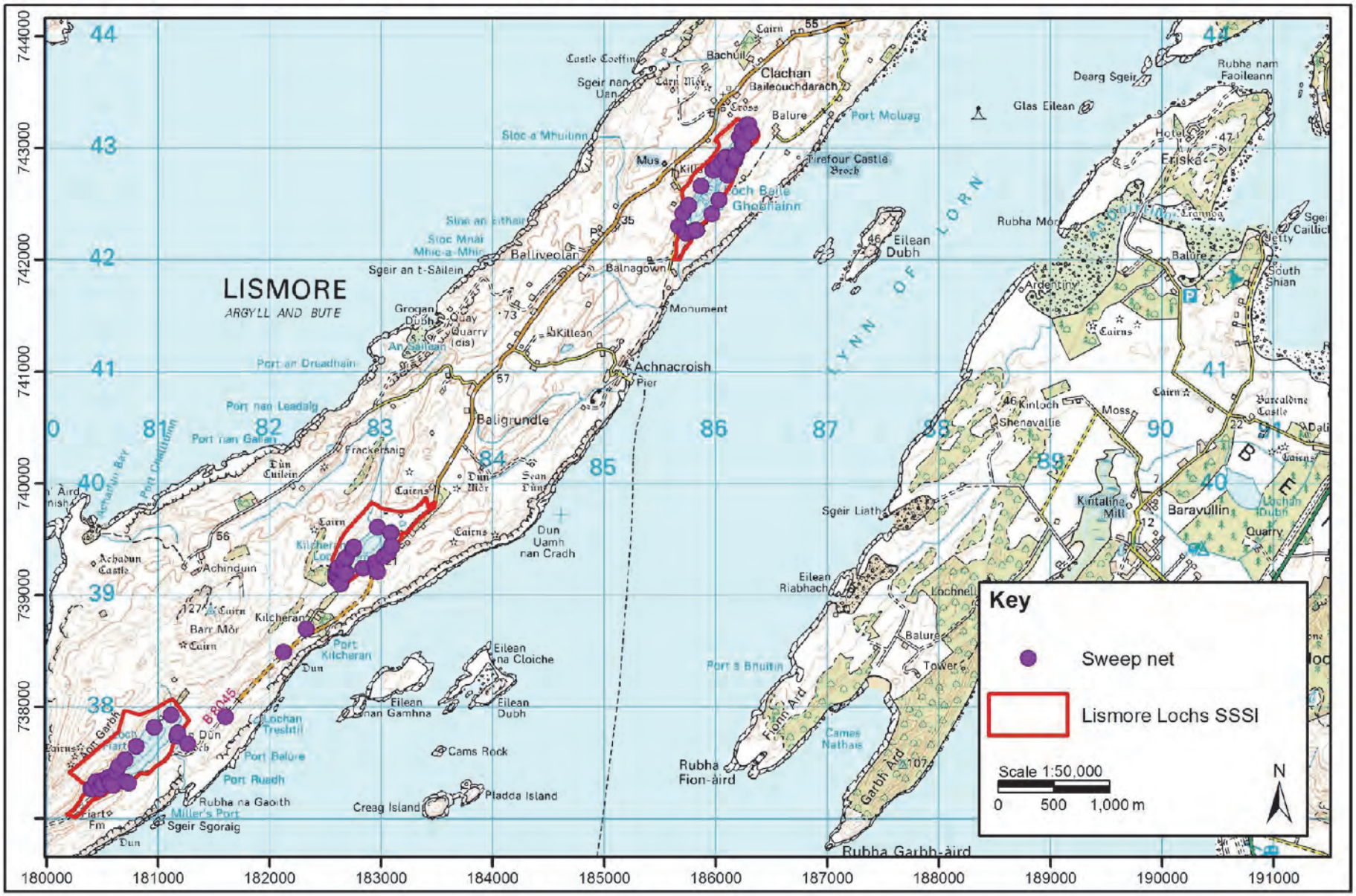

Figure 3.29. Sample locations in Lismore Lochs SSSI

3.14.6 Site management recommendations

The main site recommendations for maintaining suitable *D. aquatica* habitat is to retain large stands of sedge-dominated emergent vegetation and protect these against excessive disturbance. Emergent vegetation was sparse at the north-eastern end of Loch Fiart, and sedges on the banks showed signs of grazing. Fenced areas around all three lochs appeared to contain much better habitat for *D. aquatica.* Preserving a fairly stable water level is important for this species as larvae feed on submerged vegetation.

Grazing by cattle and mostly sheep was observed around each of the three lochs. In unfenced areas, some of the vegetation was closely grazed, although the areas where adult *E. aurinia* were recorded tended to have less evidence of grazing. Light all-year-round grazing by cattle (0.2-0.3 livestock units/ha) is the preferred method of maintaining an open sward with suitable quantities of *S. pratensis* for *E. aurinia.* Periodic scrub clearance may be required. Uncontrolled burning, drainage, agricultural improvement, grazing by sheep and cessation of grazing can all be detrimental.

3.15 Loch Lubnaig Marshes

3.15.1 Site description

Loch Lubnaig Marshes SSSI comprises the largest (63 ha) and least disturbed area of open water transition fen in Stirling. It is an integral part of the freshwater system which includes the rivers Balvag, Leny and Teith, and lochs Doine, Voil and Lubnaig. This system supports an outstanding range of freshwater, plant and animal communities in natural succession – several of which are the most species-rich of their type in Britain. The site supports freshwater pearl mussels (*Margaritifera margaritifera*) as well as the fly assemblage (Diptera) considered as part of this study.

3.15.2 Summary of known invertebrate interests

Notified fly assemblage feature.

Tetanocera freyi RDB3
Tetanocera freyi is a RDB3 fly found in wetland habitats with a predominant coastal distribution. The larvae of other species in the same family are obligate predators of snails ranging from aquatic to terrestrial, and it is probable that *T. freyi* shares this strategy (Rozkosny, 1984). There are no published ecological data for this species and without such basic information it is difficult to make assessments of habitat condition detailed enough to ensure the requirements of the species are taken fully into account.

Cordilura atrata NS
Cordilura atrata is a nationally scarce species mainly confined to the Scottish Highlands, with outlier populations in northern England. As with other species in the genus, this fly is associated with sedge swamps and the larvae are likely to feed on the flower-bearing stalks (culms) of sedges (Ball, unpublished).

3.15.3 Methods

We sampled adult Diptera on 3 June 2013 by sweep netting along a transect attempting to cover a representative area of wetland habitats around Loch Lubnaig (Figure 3.30). One sweep consisted of moving the net back and forth through the vegetation ahead whilst walking slowly, covering approximately a 10 x 1 m section of ground. The weather was reasonably dry at the beginning of the day but heavy showers in the afternoon truncated the survey.

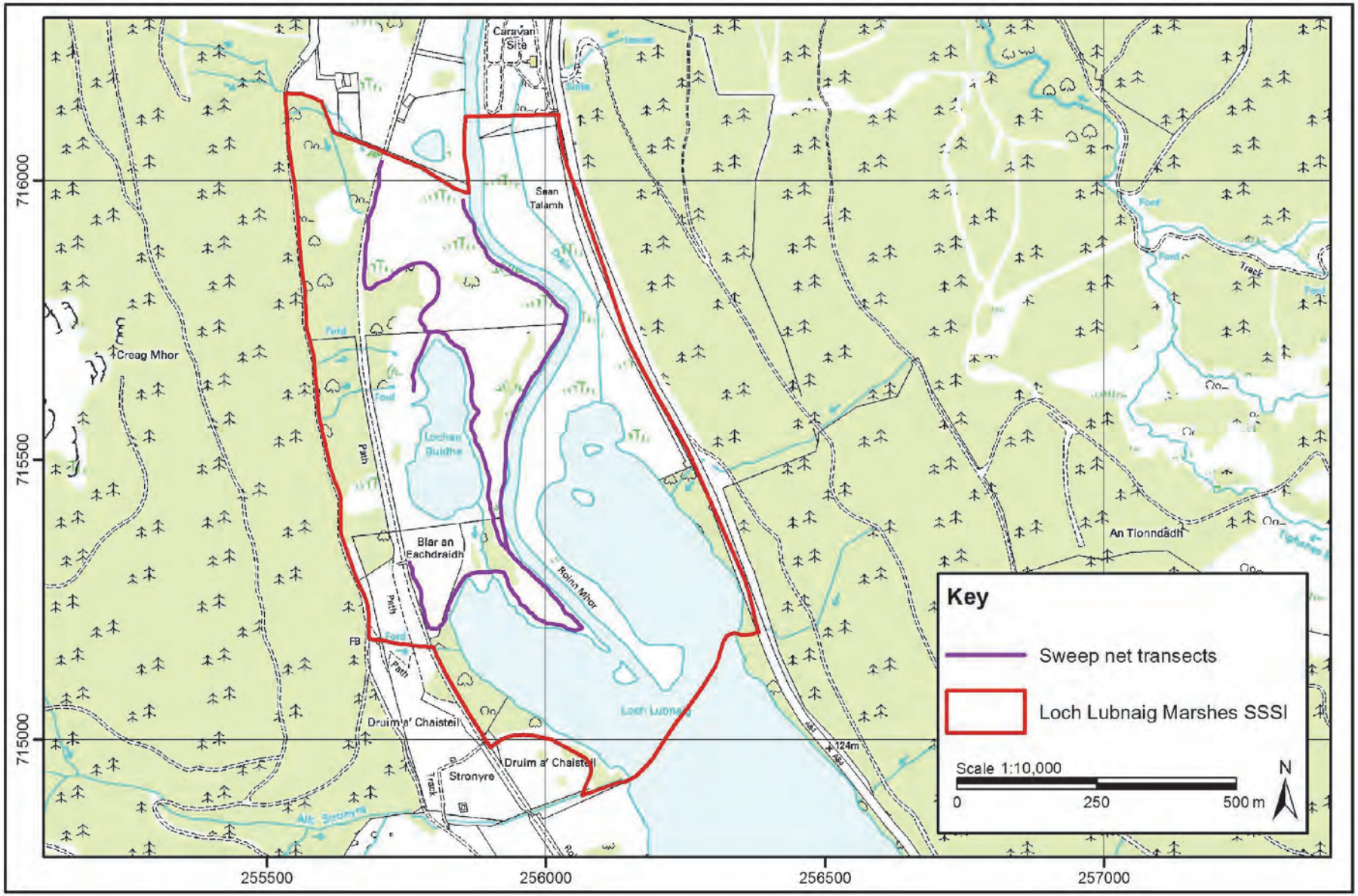

Figure 3.30. Transect route in Loch Lubnaig Marshes SSSI

3.15.4 Results

Specimens of both *C. atrata* (one male and one female) and *T. freyi* (two males) were captured at NN558153 on 3 June from bottle sedge (*Carex rostrata*) habitats adjoining the edge of the loch (Figure 3.86). We also found the nationally scarce hoverfly *Platycheirus podagratus* (two males and two females at NN558153 on 3 June).

3.15.5 Site condition evaluation

Both of the key Diptera species were found, and the habitat they are associated with is in good condition.

3.15.6 Site management recommendations

The persistence of these species at Loch Lubnaig Marshes is likely to be affected by the condition of the open water. Management that maintains the site's current hydrology and vegetation communities should be encouraged. Such management is already set out in the Site Management Statement prepared by SNH. We also recommend that the nationally scarce hoverfly *P. podagratus* is included in future SCM.

3.16 North Rothiemurchus Pinewood

3.16.1 Site description

North Rothiemurchus Pinewood SSSI is located between the River Spey and the Cairngorm hills. Most of the site lies between 210 and 430 m in elevation, supporting important components of the montane and sub-montane communities of the Cairngorm massif. The soils are derived mostly from glacial moraines of granite schistose material giving rise to acidic conditions. The site contains Britain's second largest area of Caledonian forest, including both ancient and recently establish woodlands, juniper scrub, dry and wet heath, bog woodland and clear water lochans, covering an area of 1,510 ha. Many areas are heavily used for a variety of recreational activities including horse riding, hiking, cycling, etc. These activities are, however, generally limited to well-marked paths or areas.

The site supports a variety of biological features, including fungi, lichen and vascular plant assemblages, native pinewood, breeding bird assemblage, capercaillie, crested tit, osprey, Scottish crossbill as well as the invertebrate assemblage considered as part of this study.

3.16.2 Summary of known invertebrate interests

This study surveyed the notified invertebrate assemblage feature.

Araneae: *C. subsultans*; Hymenoptera: *F. exsecta, O. uncinata*; Odonata: *C. hastulatum*; and Coleoptera:

Dryops nitidulus RDB3
A member of the family Dryopidae (long-toed water beetles), this semi-aquatic beetle straddles aquatic and terrestrial habitats. It is not a strong swimmer and, instead, walks in water as it would on land with an alternate leg motion. It retains a bubble of air beneath its elytra, allowing it to remain submerged for periods of time. It is often found in streams and damp habitats in montane areas.

Hydrochus brevis RDB3
This is an oblong water beetle of 3 mm in size most commonly found in flooded moss and plant litter in well vegetated pools and bogs. Adults are aquatic but do not swim, moving slowly through submerged vegetation, and feeding on algae. The diet of the larvae is unknown, but their large piercing jaws suggest they are carnivorous.

3.16.3 Methods

Fieldwork was completed in 2013.

3.16.3.1 *Terrestrial invertebrates (excluding* F. exsecta*)*

A transect of four nest boxes were placed in Caledonian pine forest in the west part of the North Rothiemurcus Pinewood on 13 June and collected on 1 August. For *O. uncinata,* we used transects along forest rides in optimal weather conditions (above 15 °C and no cloud cover). We targeted rides with preferred food plants - bird's foot trefoil, gorse and broom (*Cytisus scoparius*).

The beetles are aquatic and therefore we used pond dipping and vegetation sieving. The latter consisted of using the pond net to sweep the water and sort through the vegetation in a white tray, often waiting some time for insects that feign death to become active. For areas where vegetation was less thick, we used a sieve to drain water from the catch. This took place at each section of the pools that had suitable habitat. Shallow pools and streams with plenty of vegetation nearby were sampled using these two methods on 13 and 20 June (Table 3.23 and Figure 3.31).

Table 3.23. Terrestrial invertebrate sample locations at North Rothiemurchus Pinewood

Grid reference	Sampling method	Location description
NH9031009862	Nest boxes	Young Scots pine trees within Caledonian pine forest
NH9029609873	Nest boxes	Young Scots pine trees within Caledonian pine forest
NH9028409871	Nest boxes	Young Scots pine trees within Caledonian pine forest
NH9027809856	Nest boxes	Young Scots pine trees within Caledonian pine forest
NH9216109503	Nest boxes	Young Scots pine trees on the bank of a stream
NH9217009494	Nest boxes	Young Scots pine trees on the bank of a stream
NH9217009484	Nest boxes	Young Scots pine trees on the bank of a stream
NH9217609483	Nest boxes	Young Scots pine trees on the bank of a stream
NH8978709861	Pond dipping	Pool heavily vegetated with sedges and reeds
NH8984309534	Pond dipping	Sedge and reed dominated bank of Lochan Mor
NH8989509352	Pond dipping	Sedge and reed dominated bank of Lochan Mor
NH8997909544	Pond dipping	Sedge and reed dominated bank of Lochan Mor
NH9005809488	Pond dipping	Sedge and reed dominated bank of Lochan Mor

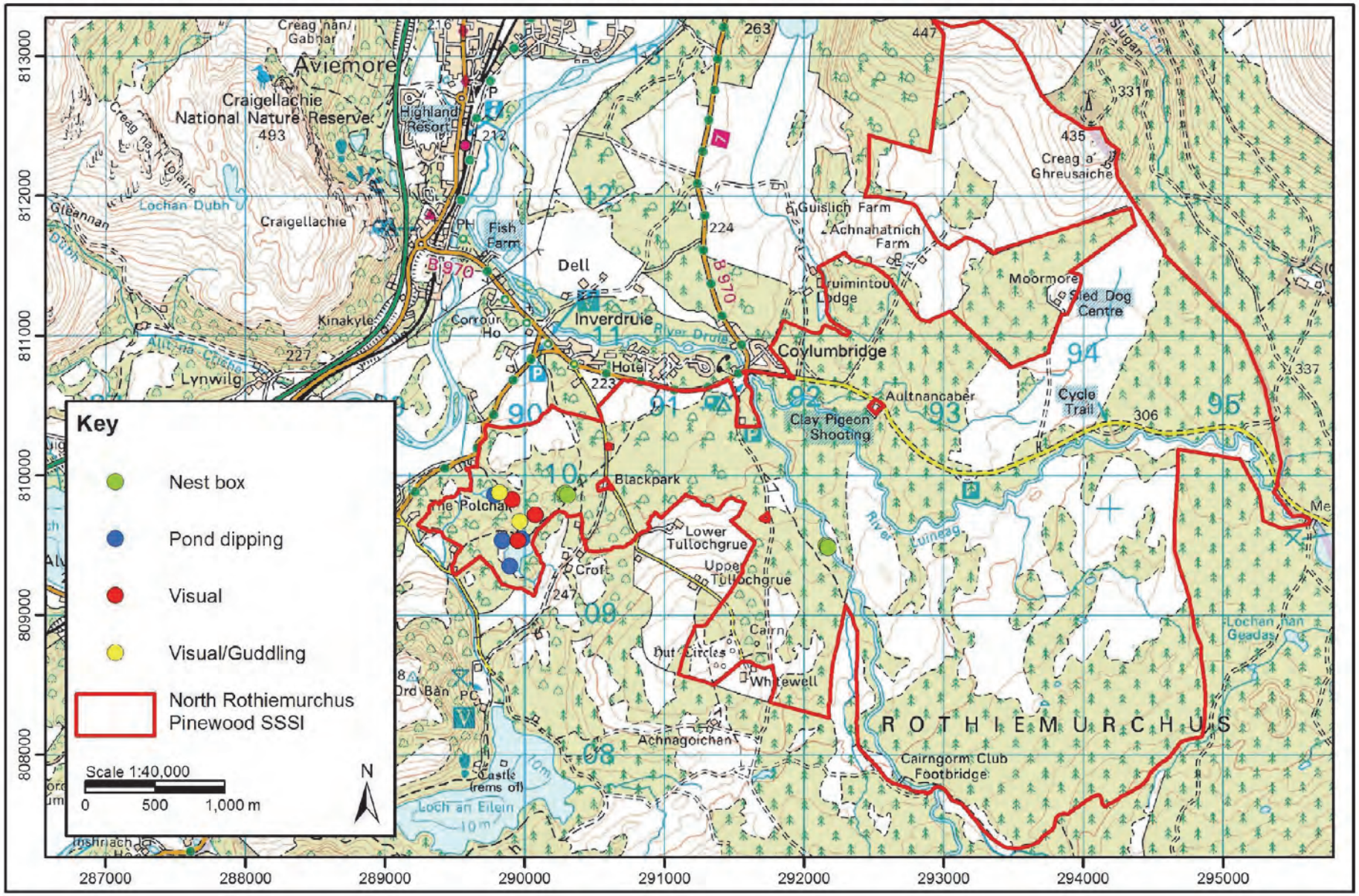

Figure 3.31. Sample locations in North Rothiemurchus Pinewood SSSI

3.16.3.2 *Formica exsecta*

When the site was surveyed by Gus Jones in 1996 and 1997, 52 *F. exsecta* nests were found (Gus Jones, pers. comm.). The ant exists along the main road in good numbers; however, since construction of the "Old Logging Way" cycle path, the number of nests has declined either through direct disturbance or habitat change associated with the footpath (Gus Jones, pers. comm.). A survey of the roadside colonies by Keith Duncan in 2004 highlighted nests prior to creation of cycle path. Colonies had also been recorded north of the main road and close to the entrance to the Sled dog centre, on the southern embankment (Gus Jones, pers. comm.).

No records of *F. exsecta* could be provided by the Rothiemurchus estate. After seeking advice from Gus Jones, the survey was focused in the 1 km squares NH9410 and NH9510 where the majority of nests had been previously noted. A selection of 1 km squares was surveyed on 2, 8, 19 and 20 August on dry, sunny days when the ants would be active. The survey methods followed those described previously.

3.16.3.3 *Odonata*

This site was visited twice, on 18 and 19 July. The weather was sunny and between 22 and 25 ºC. Sample locations are shown in Figure 3.31 ('visual' and 'guddling').

3.16.4 Results

3.16.4.1 *Terrestrial invertebrates (excluding* F. exsecta*)*

Two *C. subsultans* females were identified from a spider nest box set on a young Scots pine tree less than 20-years-old at NH9028409871 on 1 August. The habitat is dominated by large Scots pine trees with a heather layer and is open, allowing much sunlight to the ground (Figure 3.87). *Osmia uncinata* was not found, but its habitat was optimal and well-used paths often exhibited the preferred food-plants. Despite pond-dipping seven lochans and pools thick with vegetation, neither *D. nitidulus* nor *H. brevis* were discovered. The site offers suitable habitat, however, so it is likely they persist in the area (Figures 3.88 and 3.89).

3.16.4.2 *Formica exsecta*

Nest locations are shown in Figure 3.32. The results are discussed for each survey area.

Sleddog Centre sign: two active *F. exsecta* nests on the south side of the road on the south-facing, grassy embankment (Figure. 3.90), last noted by Keith Duncan in 2004. The nests are in a small glade surrounded by dense Scots pine plantation. They are significantly isolated from other nests in the site and have little opportunity to spread into the surrounding forest due unsuitable habitat. A third nest existed here (Gus Jones pers. comm.) but has since been shaded out.

Main road and along Old Logging Way Cycle Path: we found nine active *F. exsecta* nests in the periphery (Figure 3.91). Four are believed to have been originally recorded by Gus Jones in 1996-1997. Two nests were immediately adjacent to the main road and one was immediately adjacent to the cycle path, although all appeared to be in good condition and not disturbed. One isolated nest was situated in a small glade on the south side of the road. We were unable to locate other 11 nests recorded by Gus Jones in 1996-1997. It is likely that these nests have been abandoned, some almost certainly from shading created by regenerating trees along the roadside.

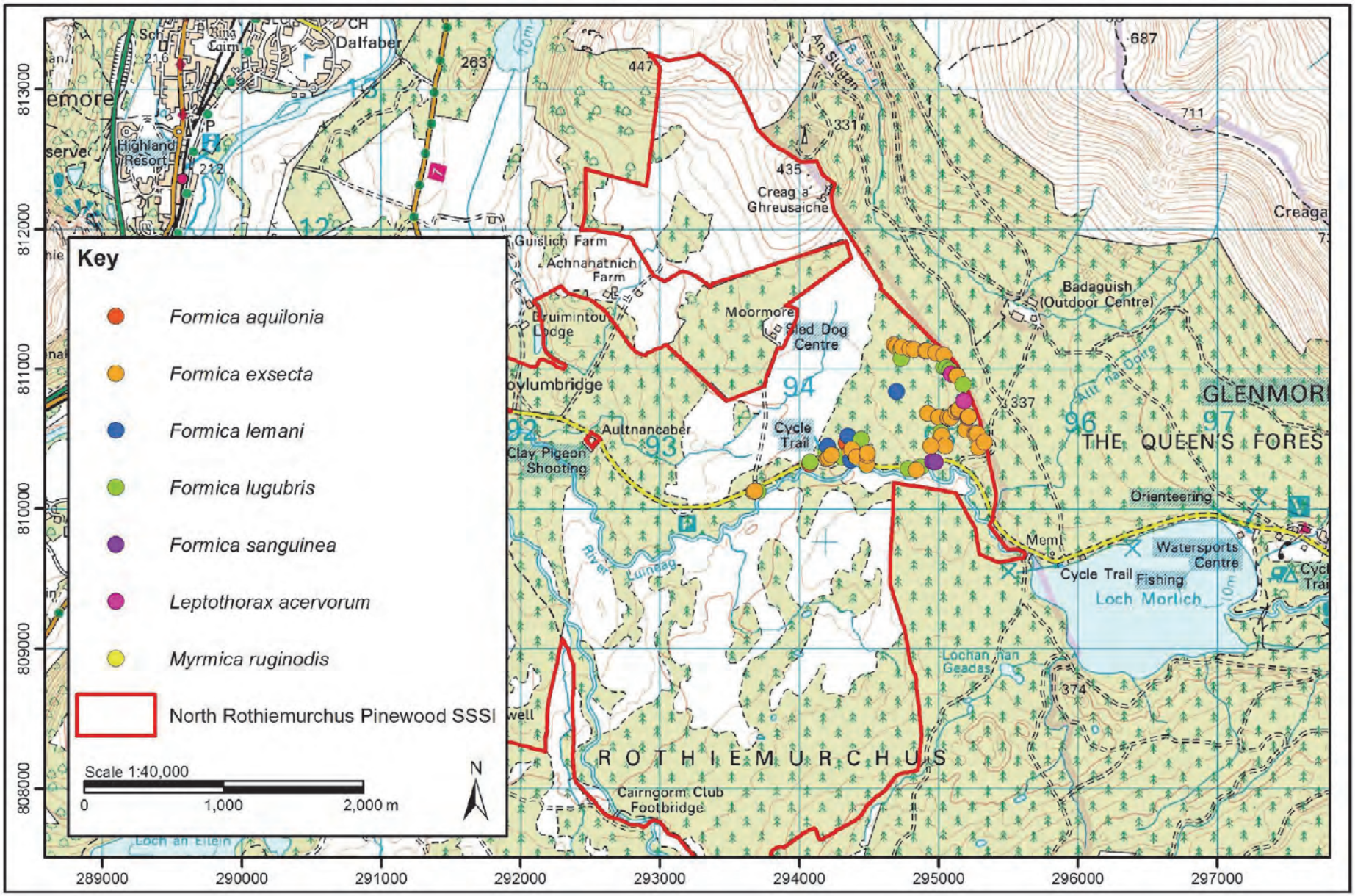

Figure 3.32. Ant nest locations in North Rothiemurchus Pinewood SSSI

North of the main road, between Sleddog Centre and Glenmore: the habitat comprises Caledonian pinewood with a varied structure, consisting of older forest, younger dense thickets, large glades and bog woodland. We found 34 active *F. exsecta* nests (Figure 3.92). A significant number of these were new records (Gus Jones pers. comm.). Nine nests were along the telegraph way-leave crossing the forest west to east from the Sleddog Centre to Badaguish (Figure 3.93).

3.16.4.3 *Odonata*

Nine of the possible 12 species that have been reported here historically were recorded, with breeding proven for seven (Table 3.24). This SSSI is a well-known location for *C. hastulatum,* with one breeding site mentioned in Smith & Smith (1996). The species was found on three sites, with proof of breeding recorded at one. Two of the sites had the highest number recorded on any site visited by the surveyor (J. Willet) in 2013; over 100 individuals were seen at the Spectacle Lochans (Figures 3.89 and 3.94) and over 30 seen at The Lochans, with both sites being near The Polchar. Other species of damselfly were also in good numbers. This certainly had a lot to do with the fine, settled weather in July, but it did highlight that these are good sites for these species.

Table 3.25. List of Odonata species recorded in North Rothiemurchus SSSI compared with species recorded from this area historically

Possible Species	**All North Rothiemurchus Sites 2013**
Aeshna caerulea (azure hawker)*	
Aeshna juncea (common hawker)	X b
Coenagrion hastulatum (northern damselfly)	X b
Cordulegaster boltonii (golden-ringed dragonfly)	X
Enallagma cyathigerum (common blue damselfly)	X b
Ischnura elegans (blue-tailed damselfly)	
Lestes sponsa (emerald damselfly)	X b
Leuchorrhinia dubia (white-faced darter)	X
Libellula quadrimaculata (four-spotted chaser)	X b
Pyrrhosoma nymphula (large red damselfly)	X b
Somatochlora arctica (northern emerald)	
Sympetrum danae (black darter)	X b
Sympetrum striolatum (common darter)	
Total	9/7b

X = present; b = evidence of breeding
** Records of this species are considered to be questionable in this area*

3.16.5 Site condition evaluation

3.16.5.1 *Araneae*

C. subsultans was found to persist at the site, which offers suitable habitat to support sustainable populations of this species. It is likely that other spiders of conservation concern occur in the Caledonian forest.

3.16.5.2 *Coleoptera*

The site offers many suitable ponds and ditches for *D. nitidulus* or *H. brevis*, although neither species was found during surveys.

3.16.5.3 *Hymenoptera*

The present count of 45 active nests falls short of 52 recorded by Gus Jones in 1996-1997. Although some nests may have been overlooked, there has almost certainly been a decline in *F. exsecta* colonies. Because of tree regeneration between the main road and cycle path, nests recorded by Gus Jones have either re-located to more suitable areas or have been abandoned. The long term viability of some isolated nests will depend on localised habitat management.

Despite fragmentation of habitat caused by the construction of the cycle path, a significant number of active nests still exist on the north side of the road and the habitat here is currently considered favourable. Further north of the main road within woodland between Glenmore and the Sleddog Centre, habitat is favourable and there are opportunities in the structure of the woodland for colonies to move and expand.

Although we did not find *O. uncinata*, Glen Feshie offers ample suitable habitat for this species. We did find it at the nearby Abernethy Forest, and so it is definitely present in the wider area.

3.16.5.4 *Odonata*

Overall all the habitats visited were in good condition and most of the expected species were found, with proof of breeding recorded for the majority.

3.16.6 Site management recommendations

Ensuring the high quality and diverse habitats are maintained will benefit spiders. Although the site is already suitable for *D. nitidulus* and *H. brevis*, additional habitat could be created by blocking drainage channels in historically drained wetlands throughout the site. This would also benefit Odonata.

The ant survey only covered localised areas of the forest and a more thorough survey of the site is recommended. Gus Jones noted that nests have never been observed on the south side of the road and beyond, south of the River Luineag. It is recommended that any areas of bog woodland and forest with open canopy are surveyed for *F. exsecta* nests in future years.

The population should be monitored regularly (every three years minimum), and should include an assessment of habitat suitability. It is important to maintain a varied forest structure, encouraging grazing and disturbance that creates open glades and shorter vegetation, while allowing regeneration to occur on a level that provides colonies with a source of aphid prey without shading and encroaching on nests.

It is essential that surveys are undertaken prior to planning application submissions. The documents supporting planning applications must detail the potential impacts on invertebrates such as *F. exsecta*, and appropriate mitigation or compensation should be included in conditions of consent, if successful. If nests are translocated, it is essential that a structured monitoring approach continues for several years (Cathrine & MacIver, 2014). In addition, during construction, measures should be taken to avoid trampling, such as by walking the route in advance of works, marking *F. exsecta* nests and advising contractors of suitable set-back distances and best practices.

Open glades and rides should be maintained to provide suitable habitat for *O. uncinata*.

Other than blocking drainage channels in historically drained wetlands throughout the site, there are no specific Odonata site management recommendations.

3.17 River Spey – Insh Marshes

3.17.1 Site description

River Spey Insh Marshes SSSI is 15 km long, and forms the floodplain of the River Spey between Newtonmore and Kincraig, including Loch Insh (an excellent example of a mesotrophic loch). The site is one of the largest floodplain fens in northern Britain, and covers 1,159 ha. The vegetation consists mainly of sedge-dominated 'poor' fen communities, but other habitats such as reed beds, herb-rich swamp and willow carr wetlands are also present.

The site supports a wide variety of biological features, including vascular plant assemblage, Arctic charr (*Salvelinus alpinus*), breeding bird assemblage, breeding osprey (*Pandion haliaetus*), non-breeding whooper swans (*Cygnus cygnus*) and otter (*Lutra lutra*) as well as the invertebrate assemblage.

3.17.2 Summary of known invertebrate interests

The notified invertebrate assemblage feature was surveyed. This feature includes *D. aquatica* and *P. sobrina*.

3.17.3 Methods

Searches for *Donacia aquatica* were carried out on 9 and 11 June 2013. Sedges and rushes growing around the mouth of Loch Insh and along the River Spey were sampled by sweep net transects as described previously. A number of ditches and man-made pools on the eastern side of the River Spey were also searched (Figure 3.33).

We trapped moth on the evenings of 31 July, 8 August, 14 August and 20 August 2013 to survey for *P. sobrina.* Trapping sessions were spread out over four weeks, although adults are generally considered to be active between late July and August (Waring & Townsend, 2009). Moth trapping is weather-dependent; we chose evenings forecast to be dry overnight, without wind and preferably overcast so that overnight temperatures do not prevent moth activity. We selected two sites for trapping based on where the moth had been caught previously and accessibility for equipment (Table 3.25, Figure 3.33). We used a heath trap for two nights, and a Robinson trap for two nights (with kind permission of the RSPB). We set up the traps at dusk and collected the catch the following morning after dawn. All moths caught were identified to species.

Table 3.25. River Spey – Insh Marshes moth trap locations

Grid reference	Location description
NN7874999589	Birch woodland
NN7801399766	Aspen woodland

3.17.4 Results

Adult *D. aquatica* were found on both visits, with 40 recorded. Adults were found in sedges and emergent vegetation around the southern end of Loch Insh (Figure 3.) and at a number of locations along the banks of the River Spey (Figures 3.96 to 3.98). Adults were also swept from a ditch that empties into the Spey (NH77910107) and from sedges growing in number of man-made pools east of the River Spey (NH79150158 and NH78890152). Sweeping sedges along the bank of the River Spey at the mouth of Loch Insh was particularly productive. Two other species of Donaciinae reed beetles were recorded during

site visits: the common and widespread *Plateumaris sericea* and a single individual of the nationally scarce *Donacia obscura.*

We recorded 55 species of moth, including two male *E. vespertaria* caught on 14 August at NN7801399766. However, *P. sobrina* was not trapped.

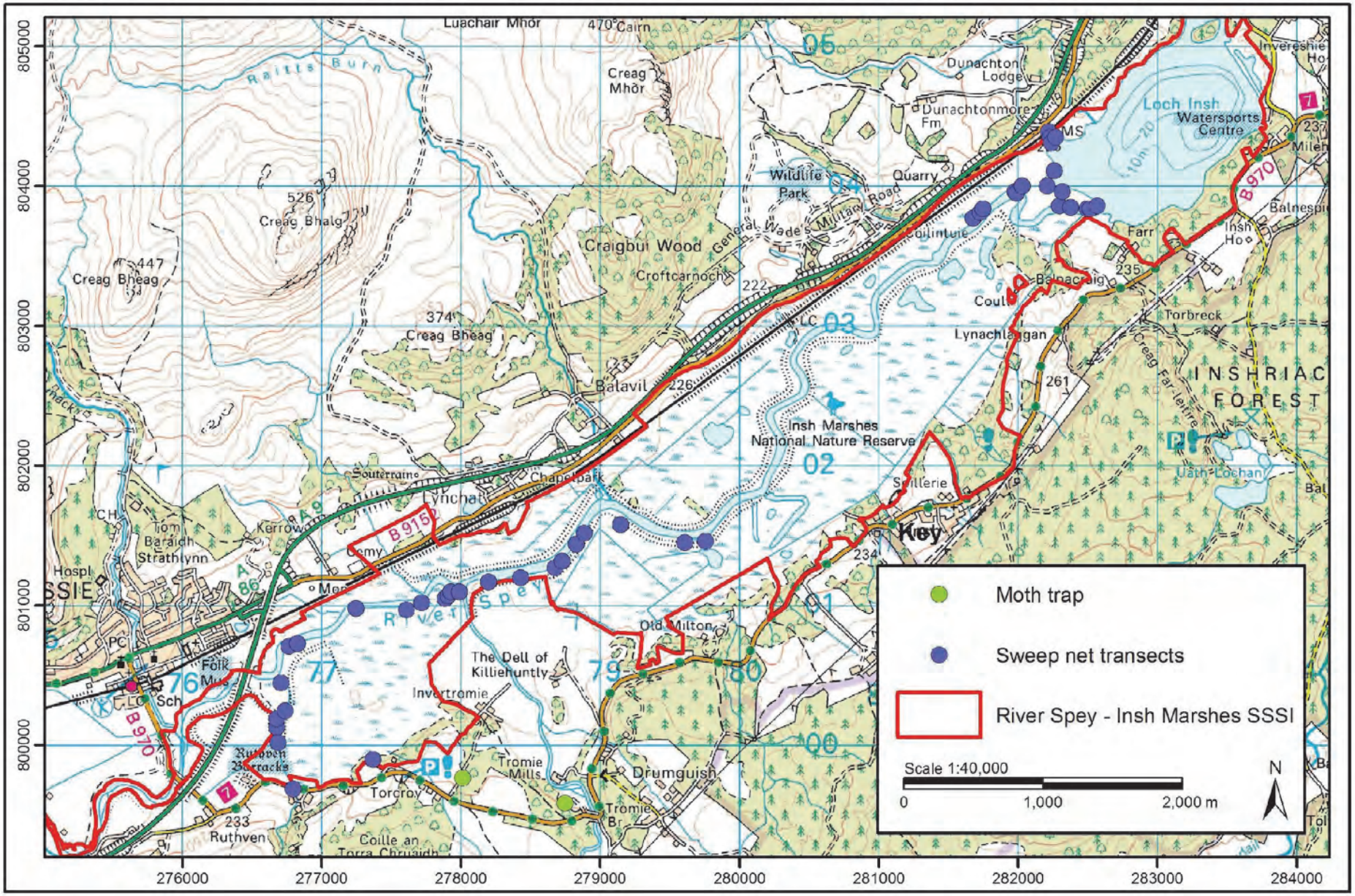

Figure 3.33. Sample locations in River Spey – Insh Marshes SSSI

3.17.5 Site management recommendations

The site appears to be offer favourable conditions for *D. aquatica* with suitable habitat around Loch Insh and along the length of the River Spey. The presence of *Carex* spp. and *D. aquatica* in man-made pools east of the River Spey suggests that these would be good way of increasing breeding habitat for this species. Preserving a fairly stable water level is important as larvae feed on submerged vegetation.

The main recommendations are to retain large stands of sedge-dominated emergent vegetation and protect these against excessive disturbance. Any work requiring the disturbance of the habitat should occur between November and February when the reed beetle and other aquatic invertebrates tend to be in their dormant phases.

It is important to maintain the preferred food plants of *P. sobrina.* Grazing should be kept at levels that allow *Betula* spp. and *Salix* spp. to regenerate and create scrub. Future monitoring should aim to detect the moth through regular trapping during the flight period.

3.18 Torridon Forest

3.18.1 Site description

Torridon Forest SSSI covers an area of 5,800 ha, and includes the mountains Beinn Alligin, Liathach ridge and Ruadh-stac Mòr to the north of Torridon village, and Sgurr Dubh and Coire a'Cheud-Chnoic to the east. These mountains provide typical western upland communities and have a low incidence of wildfires and muirburn. Of particular note are areas of sub-alpine calcareous grassland, alpine and sub alpine dry heath, alpine moss heath and siliceous screes. It should, however, be noted that wildfires in April and May 2011 have devastated huge areas, and it may take some time before they regenerate.

Although the site includes popular hill walking and scrambling routes, the extreme nature of the terrain restricts access and leaves the vast majority of montane habitats undisturbed by human recreation.

The north-facing slopes of Sgurr Dubh, Liathach ridge and Beinn Alligin support communities of Atlantic liverworts, and various rare vascular plants. The montane habitats support rare invertebrates, including *Erigone psychrophila* (chilled money-spider), a species previously included as a notified feature in older citations. Further recording, however, indicated that *E. psychrophila* is not as rare as previously thought. Furthermore, the notified spider *Micaria alpina* (alpine ant-spider) was found to have been assigned to the site in error, as the record actually relates to a specimen from Cnoc an Alaskie SSSI (Kirkland *et al.,* 2012). The site also supports beetles, wasps and ants, as well as the sawfly (Hymenoptera: Symphyta) considered as part of this study.

3.18.2 Summary of known invertebrate interests

This study considered the notified sawfly feature.

Pachynematus torridonensis RDB3 has been reared from unidentified *Carex* spp. in northern Scotland (Liston, 1980). This species has, however, since been demonstrated to be a misidentification and all specimens have been classified as *P. moerens*, a species first described in 1854 (Liston, 1995) and widespread, with no conservation designations. The most recent checklist for the sawflies of Britain and Ireland confirm the change in status and the name *P. torridonensis* is now listed as a synonym under *P. moerens* (Liston & Sheppard, 2010; Liston *et al.*, 2010). All specimens have been re-examined, and found to be *P. moerens* (Andrew Liston, pers. comm.). Although there is a specimen from Torridon Forest in the National Museums of Scotland that still bears the name *P. torridonensis*, this is an

omission. *P. torridonensis* is no longer a recognised species, therefore the notified sawfly feature is no longer valid.

3.19 Whitlaw Mosses

3.19.1 Site description

Whitlaw Mosses SSSI is made up of four wetlands comprising 21 ha – Beanrig, Blackpool, Murder Moss and Nether Whitlaw Moss – located between Selkirk and St Boswells. The wetlands occupy shallow basins in calcareous ancient marine shale overlain by glacial drift, resulting in base-rich groundwater and upwelling springs. The site provides a diverse range of fen habitats, and is part of a wider network of over 100 basin fens in the Central Borders, of which there is no similar concentration elsewhere in Britain.

The individual basins range from base-rich to acidic and support an important vascular plant assemblage, including a more northerly element of flora. The site also supports a diverse range of invertebrates, and is notified for its beetle and fly assemblages, the micro-moth *Aphelia initana* and sawflies (Hymenoptera: Symphyta), which was the target of this study.

3.19.2 Summary of known invertebrate interests

The notified sawfly feature was surveyed.

Nematus monticola RDB1
Nematus monticola is a RDB1 species with a scattered distribution across Britain. The adult flight period extends from June to July and the larvae are reported to be associated with willow (*Salix* spp.) (Liston, 1982). The Site Management Statement for Whitlaw Mosses states that the larvae feed on leaves of marsh cinquefoil (*Potentilla palustris*).

Phyllocolpa acutiserra RDB1
Phyllocolpa acutiserra is a RDB1 species apparently restricted to Scotland, and the adult flight period includes June and July (Benson, 1958; Liston *et al.* 2010). This sawfly is associated with willow (*Salix* spp), possibly grey willow (*S. cinerea*) or goat willow (*S. caprea*) and their hybrids, where the larvae form a distinctive leaf fold on the edge of the leaf. At present it is not possible to identify species by the galls they form as several other closely related sawflies have also been reared from this group of willow species. These difficulties have arisen from confusion in the precise identification of the food plant and contradictory accounts by past researchers when rearing larvae (Redfern & Shirley, 2011).

Phyllocolpa carinifrons RDB3
This sawfly is associated with bay willow (*Salix pentrandra*) in Scotland and northern England where the larvae form a distinctive leaf fold along the basal edge of the leaf. As the larvae matures, it leaves the protection of the leaf fold and feeds externally on the leaf. The adult flight period extends from May to June (Benson, 1958; Redfern & Shirley, 2011). *Pyllocolpa carinifrons* is the valid name for the species previously misidentified as *P. excavata* (Liston & Sheppard, 2010).

3.19.3 Methods

Survey visits were made in 2013 and 2014.

As the larvae of the target species are strongly associated with willow, the survey strategy involved walking the edge of the moss and making use of the boardwalks to access willow scrub. Sampling took place along our route using a sweep net to sample the foliage of willow and surrounding vegetation where adults might be present. For *P. carinifrons* we concentrated on locating the distinctive leaf folds of the larvae on the leaves of bay willow.

Nether Whitlaw Moss and Murder Moss were visited on 22 July 2013, under warm and calm weather conditions. We sampled adult sawflies by sweep-netting the foliage of the food plants and any nectar sources encountered, completing a transect at each moss. Leaf curls and leaf blisters containing larvae were also collected to rear adults in the laboratory. The survey routes are shown in Figure 3.34.

We surveyed Beanrig, Blackpool and Murder Moss on 8 June 2014, under warm conditions with a mix of heavy showers and sunshine. The Murder Moss transect involved walking much of its edge and the two boardwalks that cross it. We then moved on to Beanrig and Blackpool Moss where we used the same approach. The survey routes are shown in Figure 3.35.

3.19.4 Results

Only one of the target species, *P. carinifrons*, was confirmed as present. We found the distinctive leaf folds of the larvae to be widespread across the three mosses, especially Beanrig and Blackpool Moss (Figures 3.99 and 3.100). Leaf folds were mostly found on mature trees with plenty of foliage but on Murder Moss they were also found on low re-growth in areas where there had been past scrub clearance.

We found no specimens of *N. monticola* or *P. acutiserra*. The likely larval food plants for the three species were, however, present across the site (Figures 3.101 and 3.102). Leaf folds caused by *Phyllocopla* spp. were frequently found on grey willow. It was not possible to identify the leaf folds to species level and our attempts to rear collected larvae failed.

We did find the nationally scarce hoverfly *Melanogaster aerosa* (three females at NT510294 on 22 July 2013). This is a northern species associated with acid habitats, which is consistent with the habitat at this site (Ball & Morris, 2013).

3.19.5 Site condition evaluation

Very little ecological information exists regarding the sawfly species except basic details relating to larval food plant associations. It is therefore difficult to assess the condition of Whitlaw Mosses except to note that *P. carinifrons* was confirmed to be present, while the food plants remain in reasonable quantity on the site.

3.19.6 Site management recommendations

We have no specific management recommendations, except to ensure that a variety of *Salix* spp. remains on site and that the fen habitat with its associated flora remains intact.

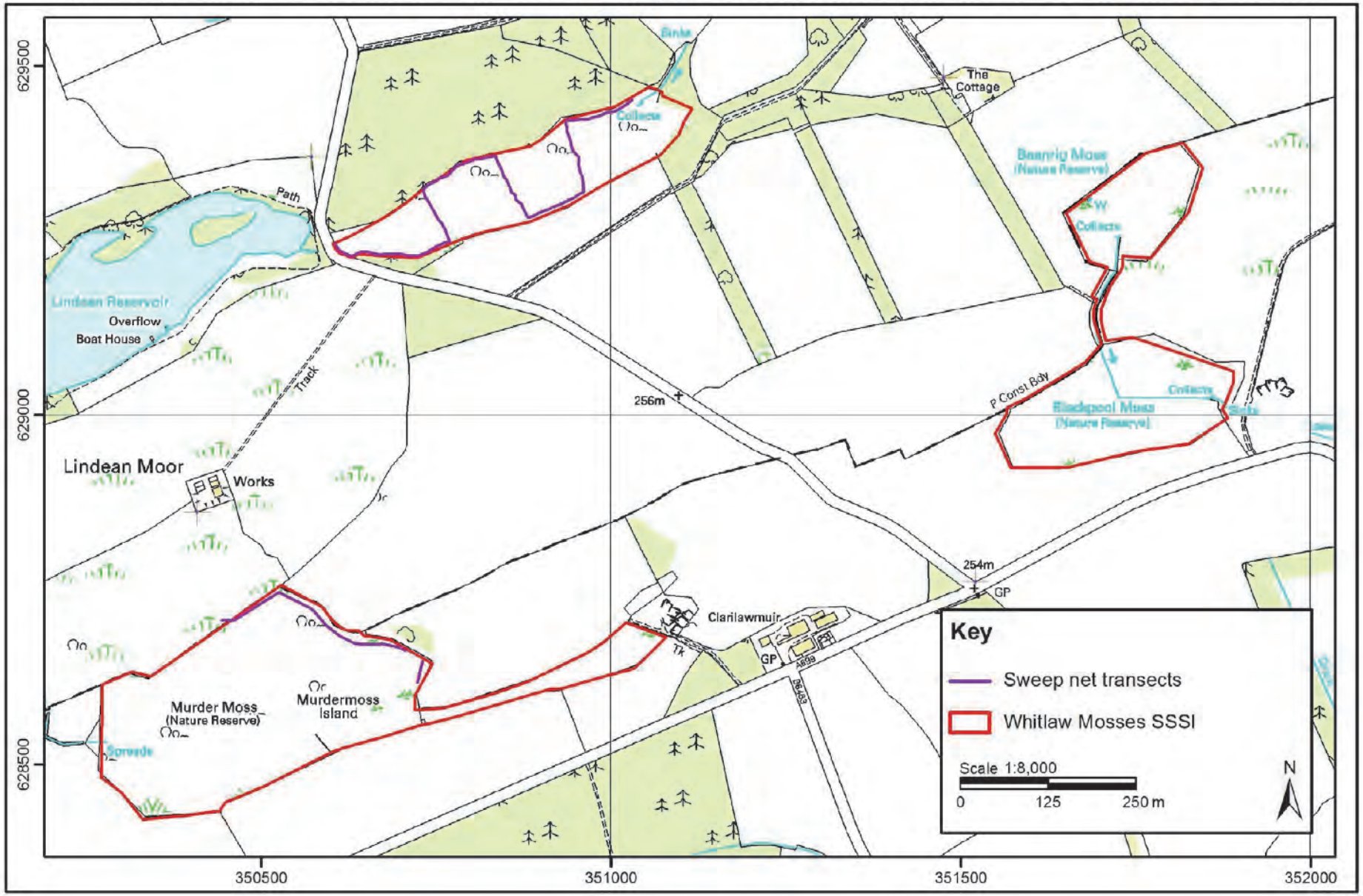

Figure 3.34. Sample route in Whitlaw Mosses SSSI in 2013

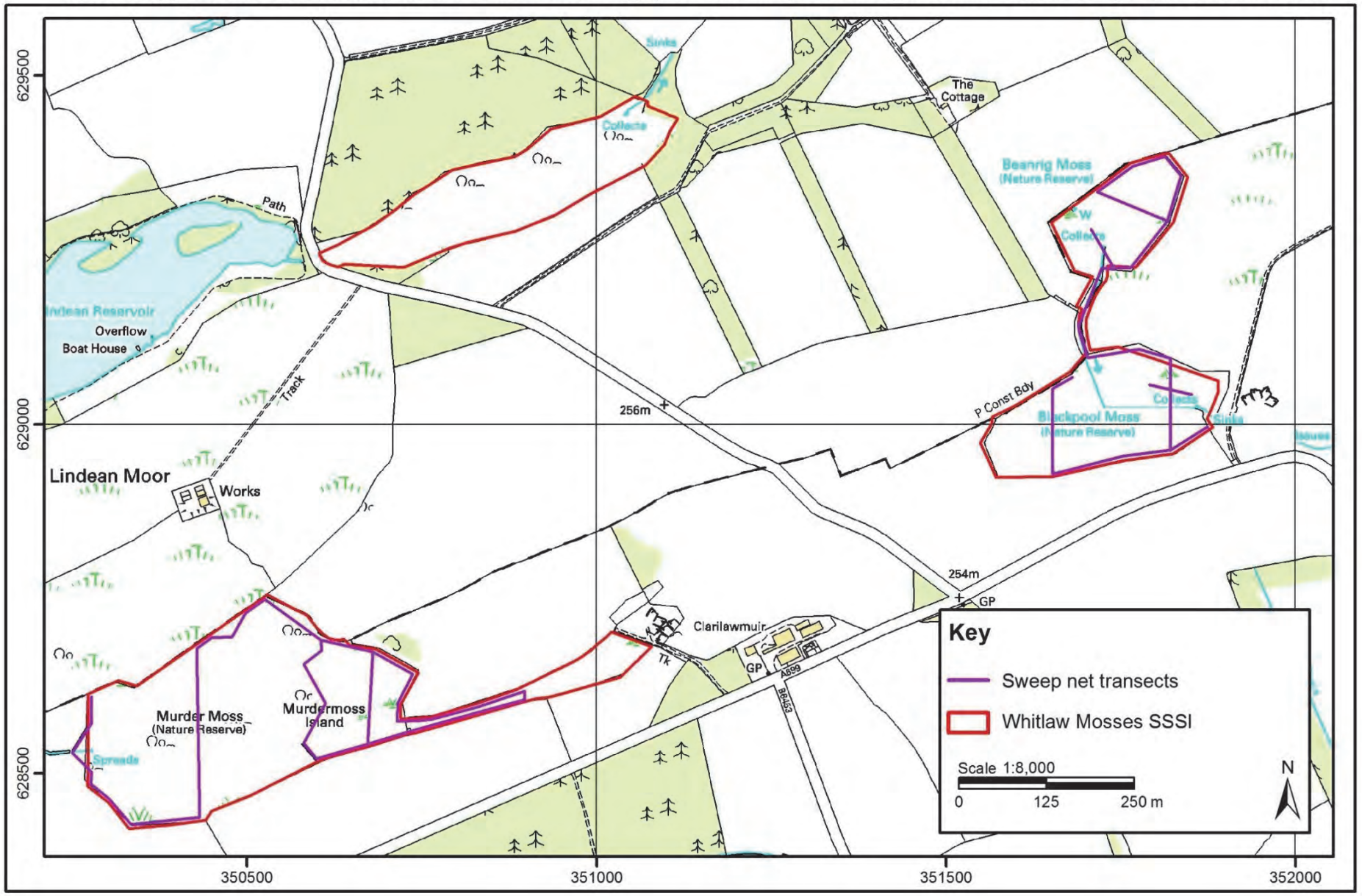

Figure 3.35. Sample route in Whitlaw Mosses SSSI

4. GENERAL RECOMMENDATIONS AND CONCLUSIONS

4.1 Feature details included within citations

The information in publically available documents such as SSSI citations is limited for many invertebrate features. In most cases, it is not possible to identify the species which have led to the inclusion in an assemblage feature. We would recommend that these are revisited, and clear consistent documentation produced to better direct future SCM and other activities.

4.2 Accessibility of information

If the appropriate species can be identified, it is generally very difficult or impossible to locate the original records on which the notification was based. We recommend that site records are collated with the highest possible level of detail, and made available publically or at the very least to future surveyors at the tendering stage of the project. This will better direct survey effort and future management of the site.

4.3 Updating of citations

We have identified a number of new species of invertebrate of conservation importance at some of the sites. Site citations should be updated to include these, and they should also be considered in future SCM.

4.4 Review of invertebrate SSSI features

It is evident that the approach to defining invertebrate features has not been consistent, and in some cases does not follow SSSI selection guidance (Bainbridge *et al.*, 2013). Also, it was not possible to determine which species were used to define invertebrate assemblage features for site notification for some SSSIs. There are also examples where individual species are included in an invertebrate assemblage feature as an individual feature in their own right at the same SSSI. A number of taxonomic revisions have occurred since site notifications were last updated, resulting in some feature species no longer being valid. Considering these factors, a comprehensive review of all invertebrate features at SSSIs in Scotland is recommended to assist site management and allow consistent SCM in the future.

4.5 Invertebrates and development

A common problem encountered throughout this project has been the lack of appropriate consideration of invertebrates during development or management activities. Developments should undertake pre-application surveys for invertebrates, and provide an assessment of potential impacts. Appropriate mitigation or compensation should be detailed and set out in conditions of consent, if the application is successful. If translocations are required, these should follow a structured approach based on species ecology, and be monitored for several years after consent. Cathrine & MacIver (2014) provided a protocol for wood ant nest translocations which considers the ecological requirements of these species.. In addition, during construction, measures should be taken to avoid impacts on invertebrates. Such measures should always be undertaken for any development if appropriate, but should be completed by experienced invertebrate ecologists at sites within or adjacent to SSSIs. Equivalent processes should be followed by public bodies (e.g. local authority, SNH, Forestry Commission Scotland, etc.) when undertaking development projects or site management.

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Figure 2.2. Bark trap design. Photo: Glenn Norris

Figure 2.3. Spider nest box design. Photo: Chris Cathrine

Figure 2.4. Bark brushing. Photo: Glenn Norris

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Figure 2.7. Heath moth trap. Photo: Chris Cathrine

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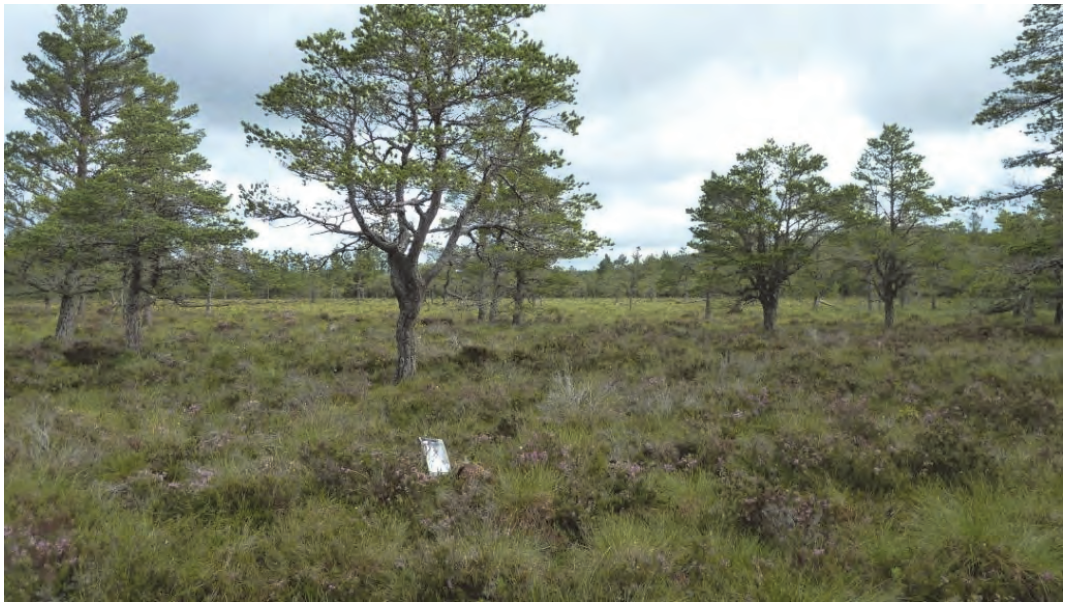

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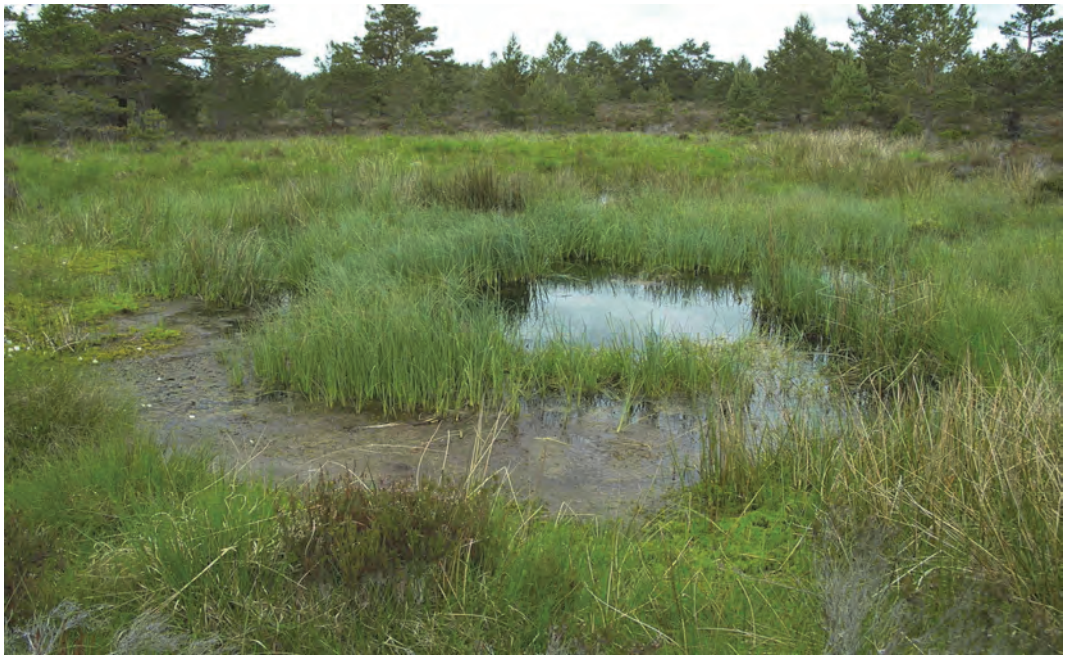

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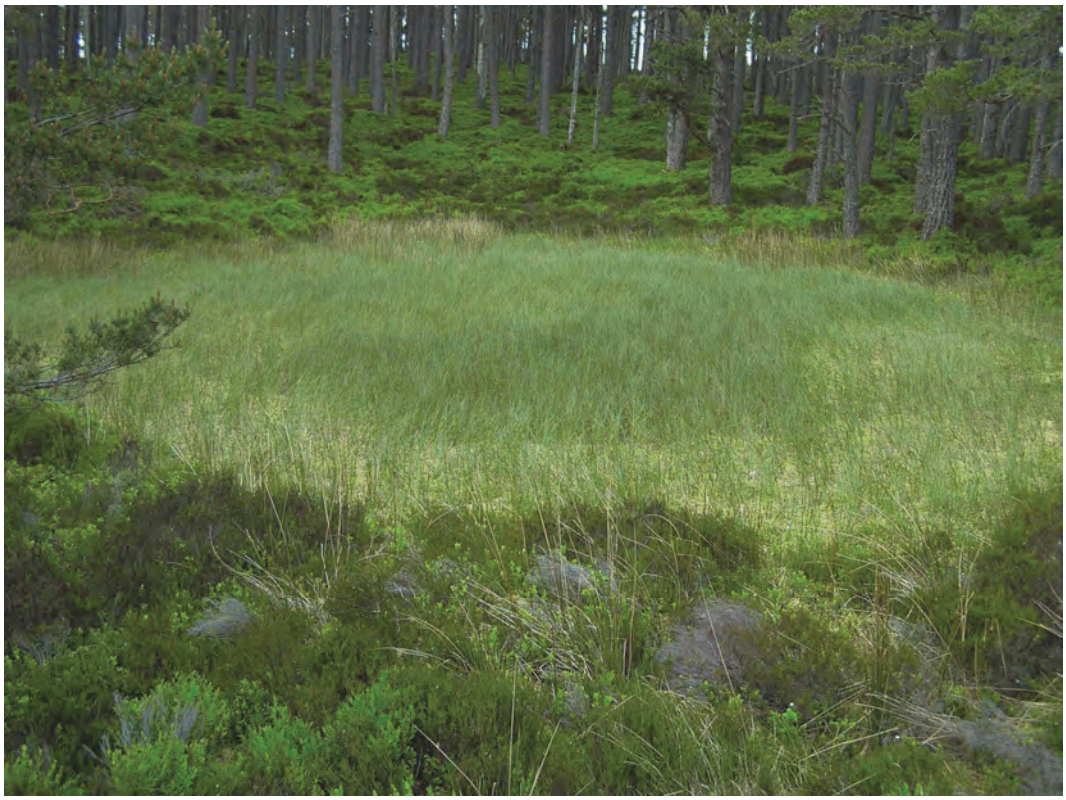

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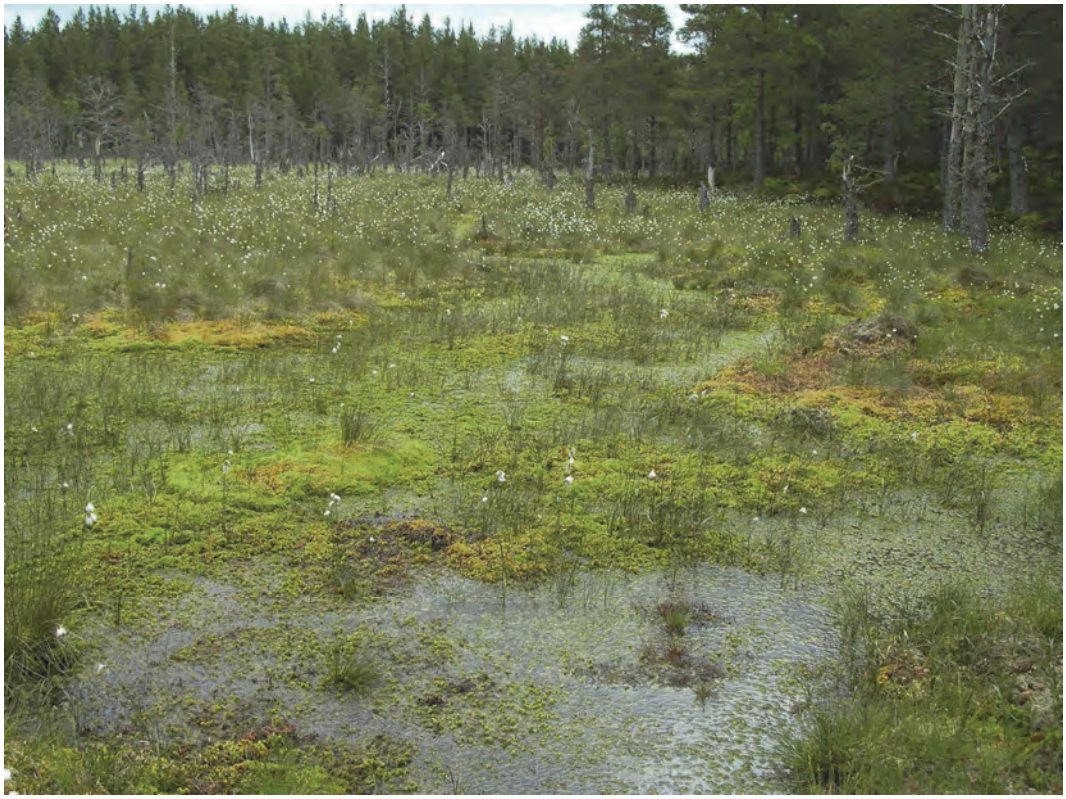

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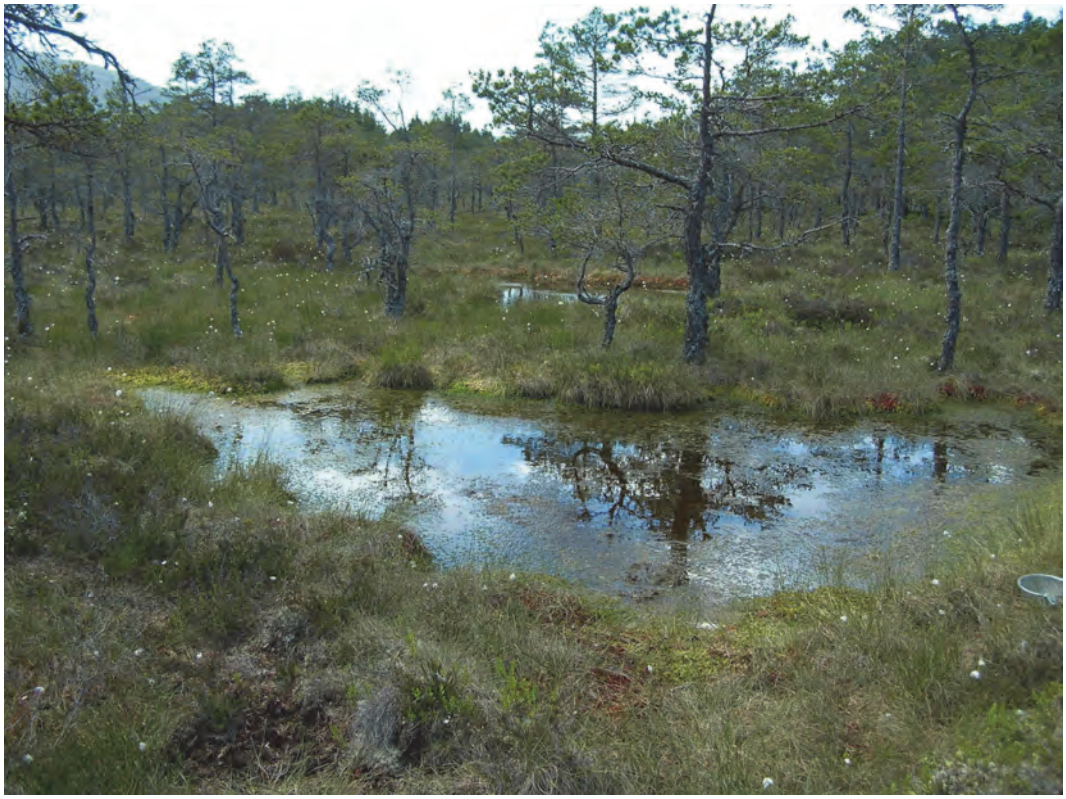

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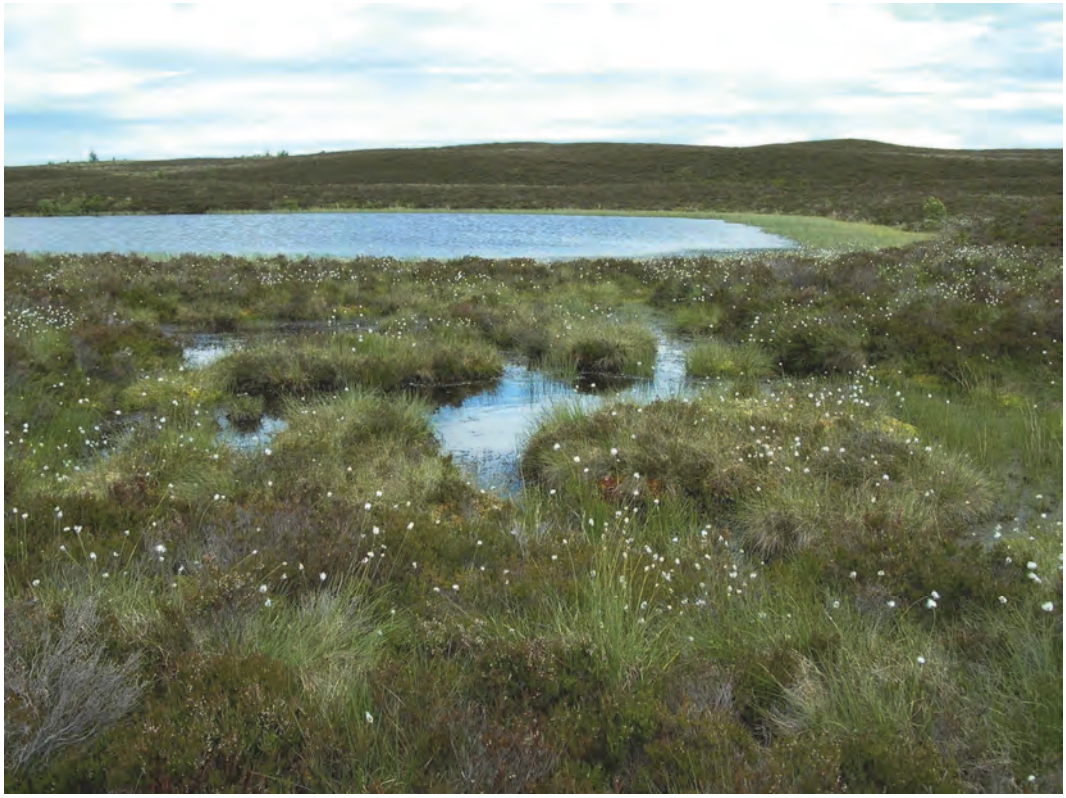

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Figure 3.66. Wet stony flush in Glen Lui, about 50 m across, where Killeen and Colville (1999) found a single Vertigo geyeri *shell, but at which we failed to find any specimens. Eastern Cairngorms SSSI (NO4969265 facing east). Photo: Chris Gleed-Owen.*

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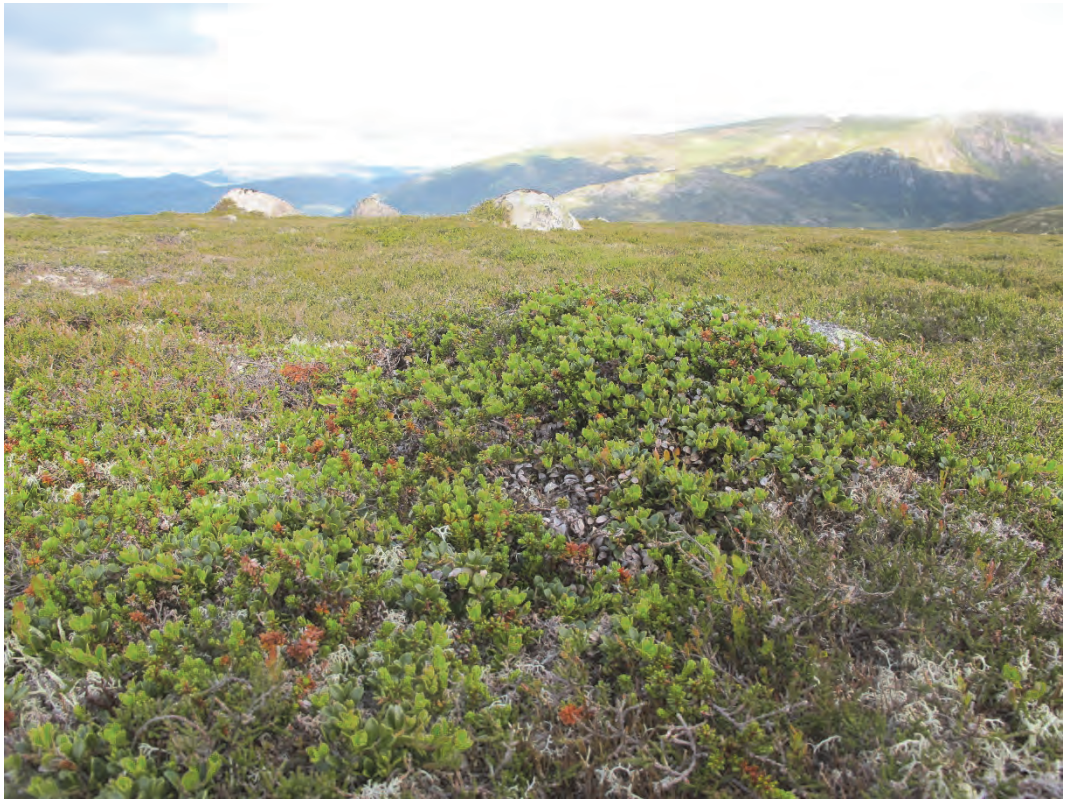

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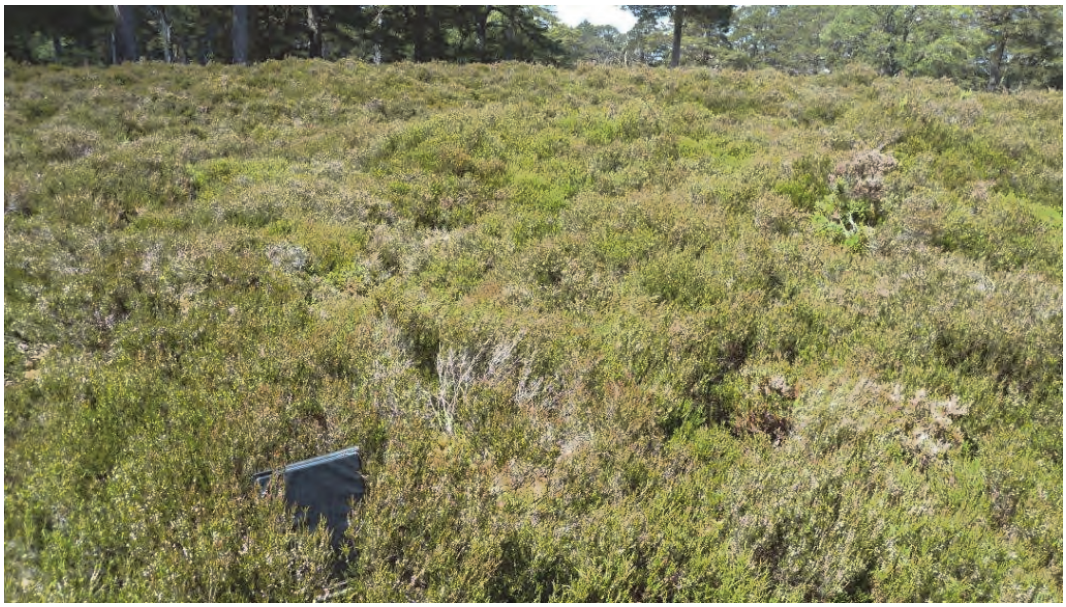

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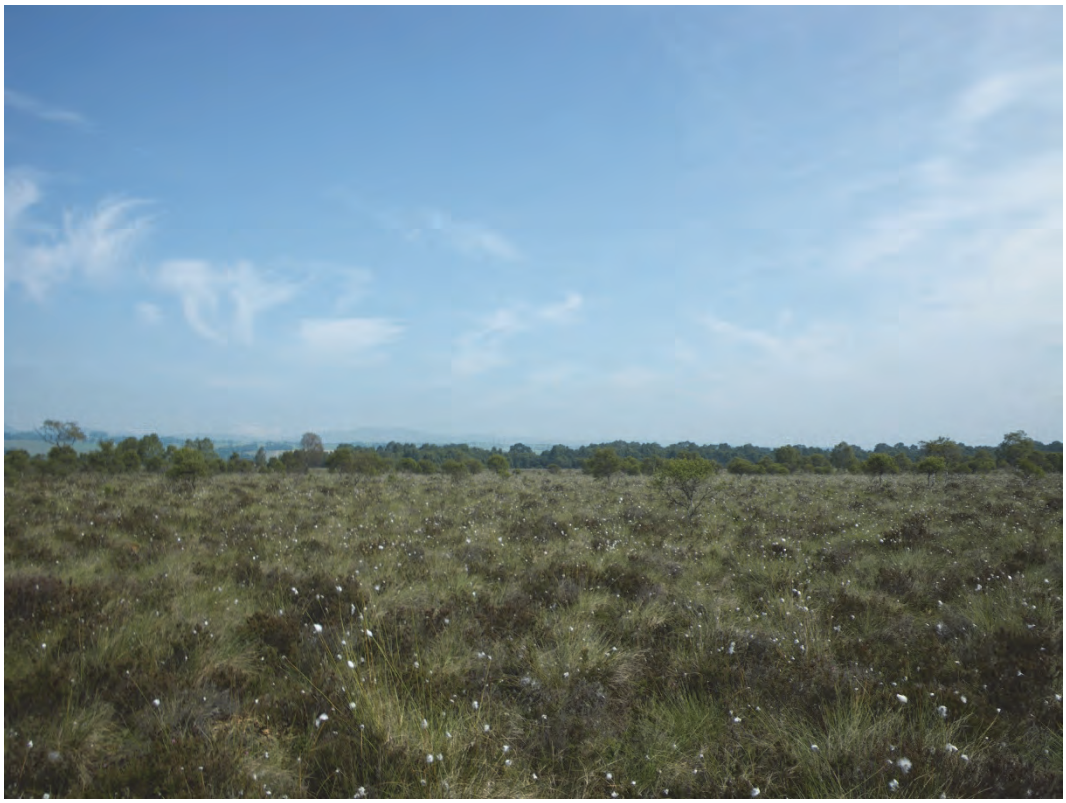

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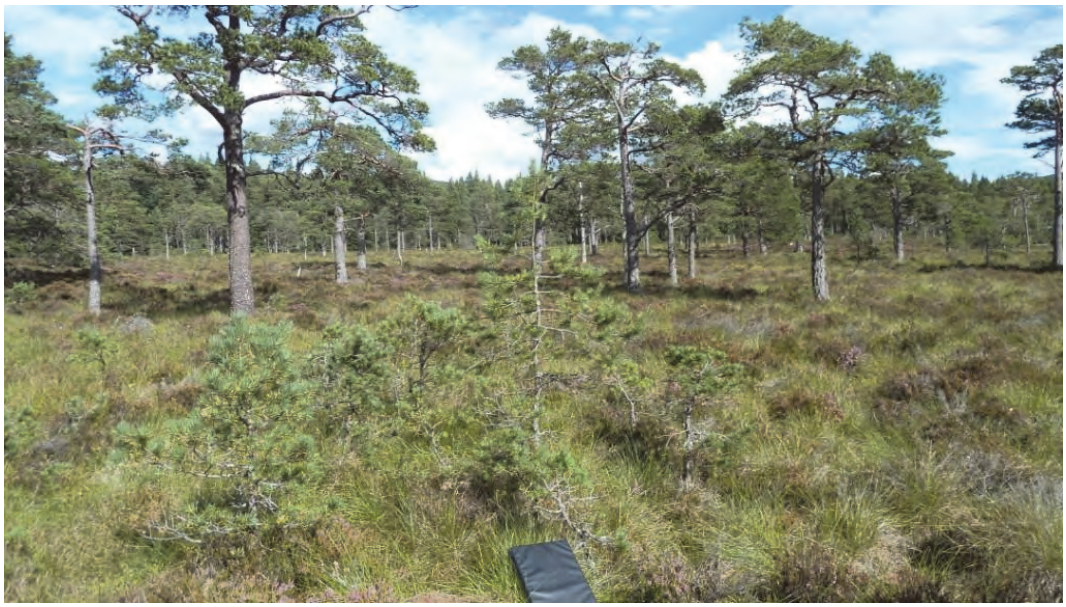

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Policy and Advice Directorate, Great Glen House,
Leachkin Road, Inverness IV3 8NW
T: 01463 725000

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