

INFORMATION NOTE

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SUMMARY

This Information Note provides information on the northern wood ant *Formica lugubris*, the Scottish wood ant *Formica aquilonia* and the narrow-headed ant *Formica exsecta*. Information is presented on the legal and conservation status, ecology, habitat requirements and management of these three species. The Note is aimed at a wide range of people with interests in wood ants and wood ant conservation, including foresters, land owners and managers, environmental organisations, local authorities, planners and policy makers.

THE IMPORTANCE OF WOOD ANTS IN FORESTS

Perhaps more than any other above ground woodland invertebrate, wood ants can be considered as a ‘keystone’ species in the forest ecosystem as they have a vital functional role through:

- influencing the distribution, abundance and community structure of many species of canopy dwelling, ground and below ground invertebrates;
- dispersing a significant number of plant seeds, particularly ancient woodland specialists;
- preying on herbivorous invertebrates and thereby indirectly increasing the growth and health of trees and woodlands;
- contributing to nutrient cycling in forests;
- providing habitats through their nests which harbour a wide range of ‘myrmecophilous’ invertebrates that are often specialist species (‘myrmecophilous’ meaning species found within wood ant nest mounds);
- providing an important food source for predators such as capercaillie (*Tetrao urogallus*).

WOOD ANTS IN SCOTLAND

Scotland has two species of true wood ant (*Formica rufa* group): the northern wood ant, *Formica lugubris* and the Scottish wood ant, *Formica aquilonia*. This Note also considers a closely related species which is associated with woodland margins and open space within woodland: the rare narrow-headed ant, *Formica exsecta*. All species are associated with conifer and birch woodland on mainly

upland, acid soils (Figure 1). Figure 2 and Table 1 give details of species taxonomy, distribution and ecology.

Other species of ants that occur within woodland habitats in Scotland are the slave-making ant, *Formica sanguinea*, the common black ants, *Formica lemni* and *Formica fusca*, and the common red ants, *Myrmica* spp. These species are not covered by this Note but further information can be found in Naturalist Handbook 24 *Ants* by Skinner and Allen (1996).


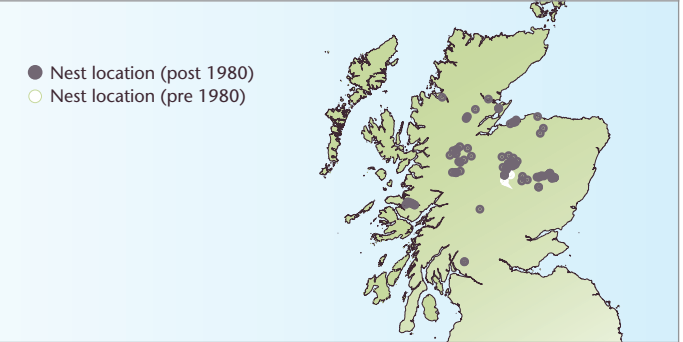

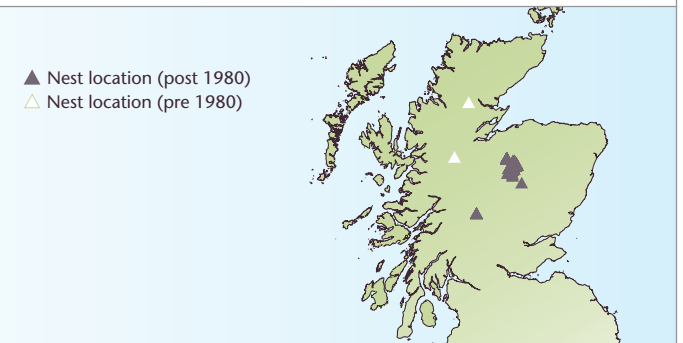

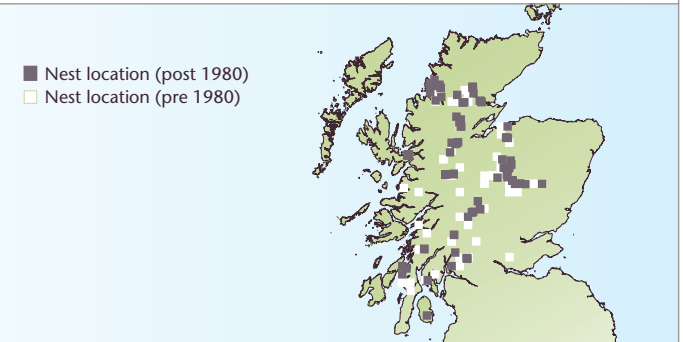
Figure 1

Wood ant nest in native pine forest, Cairngorms National Park.



Figure 2

Details of species taxonomy, distribution and ecology for the northern wood ant (a), narrow-headed ant (b) and the Scottish wood ant (c).

<p>a) Northern wood ant (<i>Formica lugubris</i>)</p>  <p>The worker ant is 8–10 mm long. When viewed from the side, the top of the thorax appears very hairy (use x20 hand lens).</p> <p>Sub-family – <i>Formicidae</i> Subgenus – The <i>rufa</i> species-group Species – <i>Formica lugubris</i>, Zetterstedt, 1838</p>	 <p>● Nest location (post 1980) ○ Nest location (pre 1980)</p> <p>Distribution: Less widely distributed than <i>Formica aquilonia</i>. The majority of the Scottish population is concentrated in a few key areas, most of which are associated with large, reasonably continuous, forest habitat networks.</p> <p>Conservation status: Former UKBAP species with Species Statement. Lower risk/near threatened on the IUCN¹ Red List of threatened species.</p>
<p>b) Narrow-headed ant (<i>Formica exsecta</i>)</p>  <p>The worker ant is 6–8 mm long with small notch on the top of its head (use x10 hand lens).</p> <p>Sub-family – <i>Formicidae</i> Subgenus – <i>Coptoformica</i>, Muller, 1923 Species – <i>Formica exsecta</i>, Nylander 1846</p>	 <p>▲ Nest location (post 1980) △ Nest location (pre 1980)</p> <p>Distribution: Known only from the Abernethy–Glenmore–Rothiemurchus complex, the Carrbridge area, Mar Lodge Estate and the Black Wood of Rannoch.</p> <p>Conservation status: UKBAP species with full Species Action Plan.</p>
<p>c) Scottish wood ant (<i>Formica aquilonia</i>)</p>  <p>The worker ant is 8–10 mm long. When viewed from the side, the top of the thorax does not appear conspicuously hairy (use x20 hand lens).</p> <p>Sub-family – <i>Formicidae</i> Subgenus – The <i>rufa</i> species-group Species – <i>Formica aquilonia</i>, Yarrow, 1955</p>	 <p>■ Nest location (post 1980) □ Nest location (pre 1980)</p> <p>Distribution: Widely distributed in Scotland away from the east coast, the central belt and the Scottish Borders. It has been recorded from two islands – Skye and Arran – and occurs as far north as Sutherland.</p> <p>Conservation status: Former UKBAP species with full Species Action Plan. Lower risk/near threatened on the IUCN¹ Red List of threatened species.</p>

¹ IUCN – International Union for the Conservation of Nature and Natural Resources.

Table 1

Details of the habitat preferences and ecology for the northern wood ant, narrow-headed ant, and the Scottish wood ant.

	Northern wood ant <i>Formica lugubris</i>	Narrow-headed ant <i>Formica exsecta</i>	Scottish wood ant <i>Formica aquilonia</i>
Habitat preferences in Scotland	Woodland edge zone of Scots pine and birch woodland where it has access to a few larger trees but occasionally within woodland, particularly where there is structural stand diversity, or out on the open heath.	Very open, Scots pine and birch woodland with a few scattered trees and saplings, often containing shrubs such as juniper. Nests are most often found just beyond the woodland edge, where the ground heats up relatively rapidly, as, unlike the true wood ants, this species cannot increase the mean temperature inside the nest by the production of metabolic heat. Also found nesting in small mires within the Caledonian pine forests. Boggy ground is considered sub-optimal habitat but may be advantageous in reducing competition from the larger wood ants.	Tolerates denser shade than the other species, but also generally prefers sunny patches within Scots pine and birch woodlands. Will persist in small woodlands, under small groups of trees, in dense regeneration or even-aged plantations and along the rides after complete canopy closure. Ability to withstand deeper shade is thought to be related to colony organisation.
Nest description	Flattened, dome-shaped mound, approximately 1 m in height and 2 m in diameter at base.	Dome-shaped mound, up to 25 cm in height and roughly 30 cm in diameter at base – about the size of half a football.	Dome-shaped mound, up to 1.5 m in height and 2 m in diameter at base.
Colony structure	Mostly polygynous ¹ and weakly polycalic ³ .	Mostly polygynous ¹ and polycalic ³ but possibly some monogynous ² monocalic ⁴ colonies occur.	Polygynous ¹ and strongly polycalic ³ .
Dispersal strategy	Nest budding ⁵ and limited dispersal of mated queens. Nuptial flights have rarely been observed in Scotland.	Nest budding ⁵ and male and queen marriage flights or over-ground dispersal.	Nest budding ⁵ and limited dispersal of mated queens.
Nest founding strategy	Nest budding and temporary social parasitism of <i>Formica lemmani</i> and <i>Formica fusca</i> .	Nest budding and temporary social parasitism of queenless nests of the common black ants, <i>Formica lemmani</i> and <i>Formica fusca</i> .	Nest budding and nest founding by mated queens.
Ant community interactions	Co-dominant with <i>Formica aquilonia</i> where multiple habitat niches are available but possibly displaces <i>Formica aquilonia</i> in ideal habitat.	The narrow-headed ant is subordinate to larger wood ants and will generally avoid their territories. It is dominant over the common black ant <i>Formica lemmani</i> which it uses as slaves. It seems to happily co-exist with common red ants <i>Myrmica</i> spp.	Co-dominant with <i>F. lugubris</i> (see entry for <i>F. lugubris</i>).
Key threat in Scotland	Insensitive and large-scale clearfelling operations which can impact on populations through both direct nest destruction and removal of food sources (mainly aphid bearing trees). Lack of management, particularly where woodland is becoming increasingly shaded and suitable habitat is not provided at woodland edge, e.g. where it borders agricultural or developed land.	At almost all sites, succession of open areas of Scots pine forests to dense thicket-stage forest. Saplings are present in most narrow-headed ant sites and shading is set to increase dramatically in the next 10 years over much of its current range.	Insensitive and large-scale clearfelling operations which can impact on populations through both direct nest destruction and removal of food sources (mainly aphid bearing trees). Lack of management, particularly where heavy shading results can reduce suitability of habitat.
	<p>Typical habitat for northern wood ant Typical habitat for narrow-headed ant Typical habitat for Scottish wood ant</p> <p>The different types of woodland structure preferred by the northern wood ant, narrow-headed ant and the Scottish wood ant.</p>		

¹ Polygynous nests contain more than one queen.

² Monogynous nests contain only one queen.

³ A polycalic colony is made up of a network of satellite nests.

⁴ A monocalic population consists of single isolated nests.

⁵ Nest budding is where one or more queens leave the nest accompanied by workers to found new nests.

POLICY AND LEGISLATION

The Scottish, northern and narrow-headed wood ants are afforded protection under Section 1(2)(b) of the Nature Conservation (Scotland) Act (2004). All three species were identified in the UK Biodiversity Action Plan (UKBAP) (The UK Biodiversity Steering Group, 1995; 1999). The Scottish and narrow-headed ants were both provided with full Species Action Plans (summarised in Box 1) which have since guided conservation effort. The northern wood ant was covered by a Species Statement and actions to protect and enhance its populations were broadly similar to those for the Scottish wood ant. This Note has been produced to support the delivery of the actions set out in the UKBAP. The recent Species and Habitats Review (The UK Biodiversity Reporting and Information Group, 2007) confirmed the priority status of the narrow-headed ant but recommended the removal of the Scottish wood ant and northern wood ant from the UKBAP list. All three species are associated with the Native Pine Woodland, Upland Birchwoods and Upland Heathland Habitat Action Plans (The UK Biodiversity Steering Group, 1999; 1995).

HABITAT REQUIREMENTS

There are a number of factors which affect the habitat or niche requirements of wood ants, including:

- Food supply
- Microclimate
- Substrate character
- Competition from other ant species
- Type of social organisation of the colony
- Dispersal ability

The broad habitat preferences of each of the species is given in Table 1. Early successional forest, permanent open glades and forest edges (shown in Table 1 and in Figure 3) tend to be colonised by the narrow-headed ant and the slave making ant *Formica sanguinea*. These species tend only to persist if the tree canopy remains open (Punntila *et al.*, 1996; Punntila, 1996). The northern wood ant thrives more on the forest edge where it has access to a few larger trees but it also has the capability of colonising young, open forests. The Scottish wood ant tends to be dominant in larger, continuous forest areas (shown in Table 1 and Figure 4) and can tolerate denser shade than the other species (Punntila *et al.*, 1994).

For all species, the primary food source is supplied by aphid colonies on trees and shrubs. Ants feed on the sugar

Box 1: Key actions for wood ant conservation drawn from the UKBAP Species Action Plans

Narrow-headed ant *Formica exsecta*.

- Seek to secure favourable management for this species at all existing sites, helping to prepare, and encouraging the implementation of management plans including protecting existing sites from damaging activities.
- Encourage monitoring of existing populations and identify any further threats to the species.
- Promote opportunities for the interpretation and conservation of the narrow-headed ant and its habitat.

Scottish wood ant *Formica aquilonia*.

- Include specific targets and management for the Scottish wood ant in Forest Design Plans, Long Term Forest Plans, and other land management plans across the species range.
- Take account of the requirements of this ant when considering Scottish forestry grant scheme applications.
- Where possible, ensure that all occupied habitat is appropriately managed, for example, through site management agreements.
- Where possible, increase the available habitat at known sites and adjacent areas, and attempt to link up existing fragments of habitat, through native pinewood expansion by natural regeneration and new planting within forest habitat networks, following the policy and delivery mechanisms laid out in the *Scottish forestry strategy* (Forestry Commission Scotland, 2006).
- Incorporate the requirements of this species in relevant development policies, plans and proposals.
- Monitor the response of the Scottish wood ant to the regeneration of Scots pine forest and birch woodland.
- Promote opportunities for the appreciation of the Scottish wood ant and the conservation issues associated with its habitats. This should be achieved through articles within appropriate journals, as well as by publicity leaflets.

Figure 3

Ideal narrow-headed ant habitat.



Figure 4

Ideal Scottish wood ant habitat.



rich liquid ‘honeydew’ that is produced by aphids, but small invertebrates are also eaten. The availability of aphid bearing trees is therefore an important factor in nest location and colony vigour.

Ants require nest temperatures of around 28–30°C to ensure optimal brood development. Nests (Figure 5) are therefore often sited on south and southeast facing aspects due to their relatively higher sunlight levels. Freely-draining substrate that warms more quickly than wetter ground is also generally preferred. At the micro-topographic scale, all the species have a preference for sheltered, sunny hotspots and will move or abandon nests to ‘follow’ high levels of sunlight.

Complex or heterogeneous, multiple-aged forest structures alleviate the effects of competition between the species as they usually contain a range of different niches. In general, the number of wood ant species is higher in mature and old growth stands and declines rapidly after canopy closure (Punttila *et al.*, 1994). However, clearfelling is also detrimental to wood ants as colonies lose their primary food source and their orientation ability which is based on visual cues (Rosengren and Pamilo, 1978). See Box 2 for more information on habitat management.

Figure 5

A typical wood ant mound.



Box 2: Checklist of management options

Management plans

Always highlight and record the locations of nest sites in management/forest plans and try to mitigate against direct damage when carrying out forestry operations, e.g. by marking off key areas with barrier tape and avoiding running over nests with machines.

Sensitive clearfelling

When clearfelling, retain individual or groups (say 8–12) of trees near any nest mounds (within 35 m) as a habitat refuge for the ants – these can be immature trees, trees of poor growth form or non-crop trees.

Retention of aphid trees

Retain aphid-rich trees when felling, thinning or managing rides and glades. These can be identified by ‘trails’ of ants which often lead to aphid-rich trees and by examining the trees themselves which will have numerous aphids being attended by ants.

Open space management

Maintain open space, tracks and rides, preferably through felling/coppicing or heavy thinning of self-seeded trees. Regular mowing of ride-sides is on balance beneficial but can also cause physical damage to nest mounds.

Grazing and browsing levels

Encourage ‘sustainable’ levels of grazing and browsing through appropriate stocking densities or deer control measures.

Targeted management in key areas

On sites where nature conservation is the primary objective, open out rides and create temporary glades around the vicinity of wood ants, particularly on south and east facing aspects.

Networks of open space

Include areas of connected open space when designing new forests and woodlands. When planting a new forest adjacent to known wood ant populations, allow some open space immediately adjacent to the existing populations.

Landscape scale action

At a landscape scale, create and restore woodland to buffer and link semi-natural habitat containing wood ants to form larger networks of habitats.

COMMUNITY ECOLOGY

Studies in the UK on predator–prey interactions in wood ants have focused on *Formica rufa* in England. These have shown that wood ants play a significant role in shaping invertebrate communities in the tree canopy and in the areas surrounding the nests. The main effects are due to predation of a wide range of invertebrate prey and through boosting populations of those aphid species which form mutualistic relationships with ants.

Wood ants have mutualistic relationships with certain species of aphid, e.g. *Cinara pinea* on Scots pine, *Cinara piceae* on spruce (Figure 6), *Periphyllus testudinaceus* on sycamore, *Betulaphis quadrituberculata*, *Glyphina betulae* and *Symydobius oblongus* on birch and *Lachnus roboris* on oak. The ants tend the aphids and thereby afford them protection from predators. In exchange, the aphids produce honeydew which can account for around 70% of the food requirements of the colony at certain times of the year (Skinner, 1980).

Because many of the insects predated by wood ants are herbivorous, e.g. the sawfly (*Neodiprion sertifer*), wood ants may have the effect of increasing the growth of trees due to reduction in defoliation. Studies in the UK, have shown that there is typically 5% less leaf area removed by phytophagous insects on ant foraged trees (Fowles, 1994). However, such effects on tree growth in the UK appear to be slight and are mainly manifested through greater elongation of shoots (Mahdi and Whittaker, 1993).

Figure 6

Formica lugubris attending the aphid *Cinara piceae* on Sitka spruce.



Wood ants are themselves a valuable food source for a number of predators, including many birds and mammals (Figure 7). Analysis of fragments of capercaillie droppings from Abernethy has shown that the Scottish wood ant and possibly narrow-headed ant are all eaten by the birds, along with common black ants (*Formica* spp.) and red ants (*Myrmica* spp.) (Collingwood, 1998).

Figure 7

Scottish wood ants are a valuable food source for capercaillie.



MONITORING

Objectives of woodland management may be to enhance the habitat for wood ants or to minimise the negative impact of forestry operations upon them. Judging whether such objectives are being met requires information on the presence and abundance of the wood ant colonies. Determining presence is the obvious first step but information on abundance will help to determine the level and type of management required. For example if the ant colony is small and the wood appears to offer sub-optimal conditions for the species, then a sensible course of action would be to target management adjacent to colony to improve conditions that would encourage colony expansion. However, if the wood appears to offer suitable conditions, then protecting the existing colony from disturbance, by zoning management operations, would be recommended. Conversely, an abundance of ant colonies may offer more scope for the manager to carry out planned operations without fear of loosing or damaging the entire population. The monitoring approach given in Box 3 will provide a measure of wood ant nest density within key areas of the woodland. Density is a useful measure as wood ant colonies can be fairly mobile. Increases in ant nest density may indicate that woodland management is benefiting wood ants. If monitoring results suggest that unfavourable changes have occurred for the species, then operations need to be reviewed with reference to the Checklist of management options (Box 2).

Box 3: Site survey and monitoring

- Decide on your survey location. This could be a part of the woodland containing a concentration of wood ant nests and parts which are to be managed near to ant colonies.

Identify an easily recognisable boundary to define the survey area, for example a fence line or a forest track. Work out the area that is being defined. This could be achieved by using a GPS to gather waypoints that are then downloaded on to a GIS. Aim for a survey area no smaller than 50 x 50 m. Ease of searching the area and the resources available for monitoring, should be considered when setting-up the survey area.

- Survey the entire area by walking from one side to another, covering the ground as evenly as possible. Passes across the area should not be more than 6–10 m apart, so that nests are not overlooked.
- Make a note of each nest when encountered, recording:
 - Nest mound size class (see Site records, item 3, below).
 - Whether nest is part of a connected cluster or is isolated
 - The species of wood ant present, if possible (see Table 1).
- Describe general habitat information for each area (see Site Records, item 3, below).

Repeat survey every 3–5 years.

Note: Additional monitoring to follow the fate of individual nests can be carried out, but it should be remembered that ant nests are fairly mobile and a loss from one point does not necessary mean that the species is in decline, as the overall density in the survey area might remain the same.

Site records should include:

1. General site information
 - Date of survey
 - Name of surveyor
 - Site name
 - Location (Region/District/6-figure grid reference)
 - Site area (hectares)
 - Owner (Name, address)
 - Status (SSSI, NNR, etc)
 - Soil type
 - Management type (e.g. selective felling)
2. Details of areas surveyed
 - Survey area identifier (name or number)
 - Survey area location (6-figure grid reference)
 - Survey area size
 - Habitat type (e.g. NVC community/main tree species)
 - Vegetation description (Main structural elements of ground vegetation including any key indicator species)
3. Description of ant nests recorded in each survey area
 - Nest identifier (e.g. number)
 - Whether part of connected cluster
 - Ant species
 - Nest size class
(small = <50 cm; medium 50–150 cm; large = >150 cm)
4. Summary of survey data for area
 - Ant species present
 - Total number of nests
 - Density of nests (number per m²)
 - Most common nest size (diameter in cm)
 - Altitude/aspect of nests

CONCLUSIONS

This Note has summarised information relating to three species of wood ant found in Scotland. Advice has been provided on how forest management can help meet the conservation needs of these species and by following this advice, the requirements set out in the UKBAP should be satisfied. The species' small size belies their important role in woodland ecosystems and it is hoped that this Note has stimulated more interest and recognition of this.

Online woodland management guidance is available from the Habitats and Rare, Priority and Protected Species (HaRPPS) decision support system: (www.forestresearch.gov.uk/harpps).

A Site Recording Form can be downloaded from: www.forestry.gov.uk/publications
Select 'Information Notes' from the drop-down menu.

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