

***Pityohyphantes phrygianus* (C. L. Koch), a possible recent colonist of Britain (Araneae: Linyphiidae)**

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**Introduction**

Additions to the list of British spiders are still made every year or so, but in most cases the spiders concerned are either rare species that may well have been overlooked in the past or forms that have been confused with other species. Here we give an account of a very different case: a conspicuous and highly distinctive species, *Pityohyphantes phrygianus* (C. L. Koch), which may have become established in Britain only in the last few years, but which now forms a substantial proportion of the fauna in suitable habitats.

*Pityohyphantes* is a genus of northern hemisphere linyphiine spiders known in North America as hammock spiders. In the Old World *P. phrygianus* has a range extending in the east at least to Siberia and Turkestan and in the west to the coasts of continental Europe (Bonnet, 1958). In the latter area it reaches 68°N in Scandinavia (Palmgren, 1975) and in the south it occurs — mainly on mountains — in France, Italy and the Balkans. Another species, *P. palilis* (L. Koch) has been described from "Galicie" apparently in S.E. Poland (Bonnet, 1958).

In North America a number of allopatric species have been described that are rather similar to the Old World *P. phrygianus*; Hackman (1954) has suggested

that we may be dealing with a single polytypic holarctic species forming geographical races. In parts of Canada, however, it appears (Blauvelt, 1936) that members of this series are sympatric with a quite distinct species, *P. limitaneus* (Emerton).

**Discovery of the British population**

*Pityohyphantes phrygianus* was first found in Britain on 28 May 1974, when B. D. Ashmole and NPA obtained an adult female in a small collection of spiders made in a spruce plantation in Glentress Forest, near Peebles (Grid Ref. NT 2743). Although immediately suspected of being something unusual, it was not sent to P. Merrett, and identified by him, until the autumn of 1975. Two visits to the area of the original find in June 1976 led to the capture of four more females in mature Norway Spruce (*Picea abies* (L.) Karst.) at NT 2742 on 27 June 1976.

The second British locality was in the Langdale Forest (Grid Ref. SE 965943) near Scarborough, Yorkshire, where a male was obtained in a pitfall trap in a plantation of Corsican Pine (*Pinus nigra* Arnold) during the period 4-18 August 1976, by JHS and AQKL. This specimen was sent to GHL for identification and he was informed of the Scottish find by P. Merrett.

The third British locality was an oakwood (*Quercus petraea* (Mattuschka) Liebl.) with a few spruce trees that forms part of the Bridestones Nature Reserve in the area of Dalby Forest, in the southeast corner of the North Yorkshire Moors, west of Scarborough; a female was found here by CJS on 5 June 1977, at SE 871906.

Given this evidence of the widespread occurrence of the species in Britain, efforts were made by CJS and NPA during the summer of 1977 to investigate conifer plantations in northeast England and southern Scotland. As a result, the species has been found at the following additional sites (See also Fig. 1):—

Elibank Forest, Peeblesshire. NPA, 29 May 77, NT 3736.

Adult female. Mature Norway Spruce.

Wauchhope Forest, Roxburghshire. NPA, 2 June 77, NT

5807. Adult females. Mature Norway Spruce.

Redesdale Forest, Northumberland. NPA, 2 June 77, NT

7802. Adult and subadult females. From mature Norway Spruce, and one from larch (*Larix* sp.) nearby.

Dalby Forest, Yorkshire. CJS, 8 August 77, SE 8688, 8689, 8790, 8890. Adult females, immature males and females.

years, but that the species is now abundant and conspicuous in its characteristic habitat, suggests that it has become established recently rather than having been overlooked in the past.

We can never know for certain how *P. phrygianus* reached Britain. In view of the large-scale importation of softwood timber from Scandinavia it is conceivable that spiders or their eggs could have arrived with help from man. However, colonists that arrive by ship are generally first recorded close to ports, a pattern not observed in *P. phrygianus*. It seems more likely that the species is a genuine natural colonist, having crossed the North Sea by ballooning.

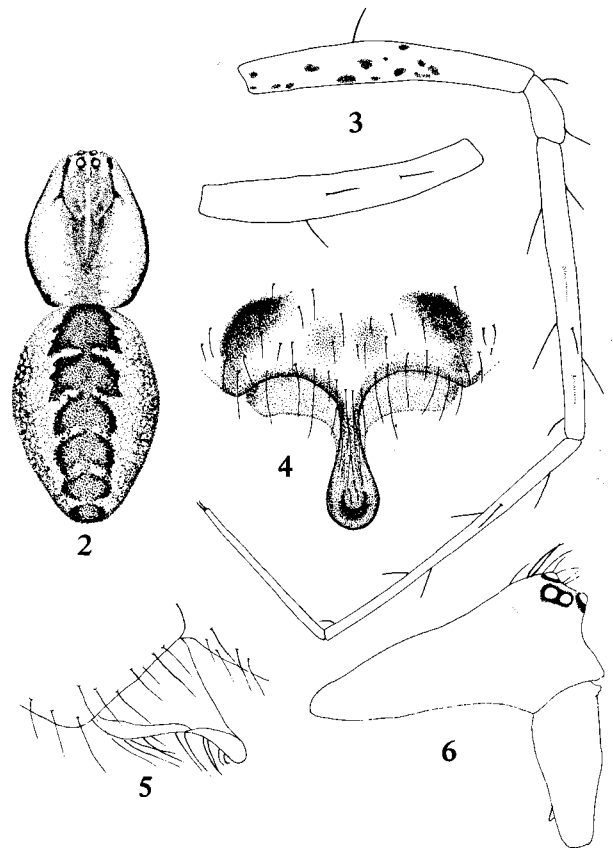
In any case, it appears that habitats suitable for *P. phrygianus* have been created in Britain mainly by recent human activity. Neither spruce nor larch is native to post-glacial Britain and it is only planting by the Forestry Commission and private forestry groups during the last 60 years that has provided substantial acreages of these trees. It must be admitted that Scots Pine (*Pinus sylvestris* L.) has been present for several thousand years, but it appears that on the continent *P. phrygianus* is predominantly an inhabitant of spruce, although Palmgren (1972) also found it to be fairly numerous on pines in southern Finland. In Scotland the species has probably been absent from the native pine woods in the past, since it has not been found during substantial collecting in the Spey Valley by Jackson (1915), Locket & Millidge (1961) and Roy (1962) and in the Black Wood of Rannoch by Jackson (1914) and Roy (1955). We have not been able to make a visit to either of these areas to see whether *P. phrygianus* is yet established there.

It seems to us likely that potentially colonizing individuals of *P. phrygianus* have arrived in Britain by air on rare occasions since the last glaciation, but that until the present century they have not found an optimum habitat available and have failed to persist. Now that we have created a habitat comparable to the boreal spruce forests to which it is adapted, the species has established itself and has become a dominant member of the spider community in some forests.

*P. phrygianus* is clearly now common in spruce plantations in North Yorkshire and in northern Northumberland and the Scottish Borders. We do not yet know whether it is also established outside these areas, but in view of its evident success within them it

seems likely that it will gradually spread to other parts of Britain where there has been large-scale planting of spruces.

There is a possibility that the establishment of *P. phrygianus* in our conifer plantations will lead to a change in the status of species previously dominant in them. In NPA's sampling in Northumberland and the Scottish Borders *Linyphia (Neriene) peltata* Wider was the species most commonly found on the lower branches of conifers; it was typically much more abundant than *P. phrygianus*. *L. peltata* was also often found in the plantations by CJS, but sites with *P. phrygianus* in the Dalby Forest (Yorkshire) almost invariably also supported large populations of *Lepthyphantes expunctus* (O.P.-C.); in addition, AQKL has found two females of *L. expunctus* in the



Figs. 2-6: *Pityohyphantes phrygianus*. 2 Carapace and abdomen markings; 3 Spine positions of female 1st right leg; 4 Epigyne (ventral); 5 Epigyne (side); 6 Male carapace.

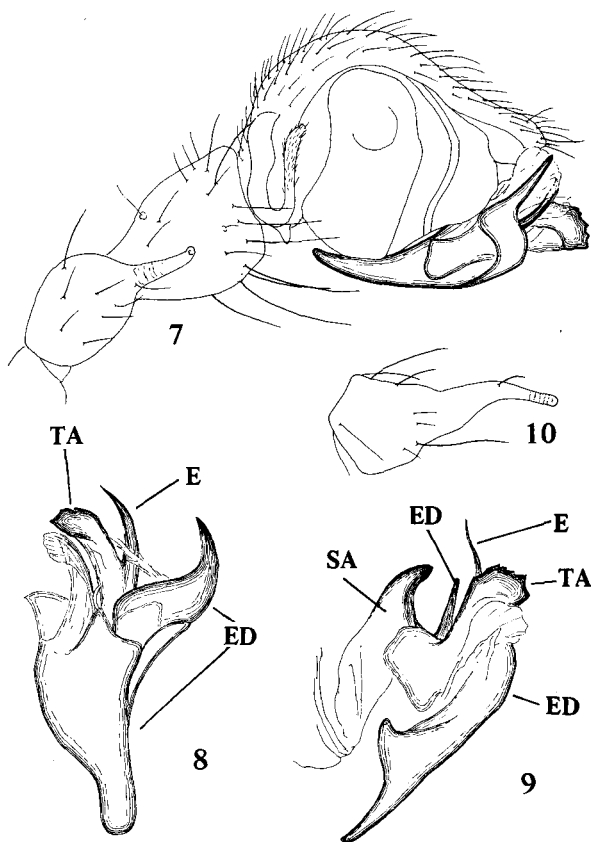
Langdale Forest. This species is locally common in Scotland, especially in pine woods, but has previously been found in England on only three occasions, in 1951, 1961 and 1967 (P. Merrett, pers. comm.). Although these records suggest that *L. expunctus* may have been overlooked in England in the past, there is also the possibility that the Yorkshire population was established recently in an aerial invasion from abroad with *P. phrygianus*. Both species are abundant in Scandinavia, although *L. expunctus* is apparently found especially in birch woods (Palmgren, 1975). Another dominant species in the Finnish spruce forests where *P. phrygianus* is so common is *Dismodicus elevatus* (C.L.K.); this species, currently recorded in Britain only in Scottish pine woods, is another possible future colonist of spruce plantations further south.

### Description

The following description, based on three British females and one male, may be useful to British workers.

#### Female

*Carapace length*: 1.73-1.95 mm. (European specimens, about 2.2 mm). *Total length*: 4.1-4.5 mm. *Carapace*: Very light brown with sepia markings as in Fig. 2 (the pattern seems characteristic of the genus) and with a dark borderline. *Eyes*: Nearly equal, AM a little smaller than the rest, 1.25 diam. apart and 2 diam. from AL. PM separated by 1.5 diam., 2-2.5 diam. from PL. *Sternum*: Darker than carapace with a dark borderline in the posterior half. *Abdomen*: A dark brown or nearly black folium on a cream or white reticulated ground (Fig. 2). The sides cream or light brown with varying dark brown reticulations, in one case with longitudinal dark brown patches. *Ventrally*: a dark, nearly black, area between epigyne and spinners is flanked by a pair of white-cream crescents. *Legs*: Ground colour as carapace. Femora with black or dark grey spots (Fig. 3), apices may be darkened completely. Tibiae usually darkened at base and apex and sometimes in the middle. Metatarsi and tarsi without markings. Femur I with 1 dorsal and 2 prolateral spines; femur II with 1 dorsal spine. Spines on tibia and metatarsus I as in Fig. 3.



Figs. 7-10: *Pityohyphantes phrygianus*. 7 Right male palp (lateral view); 8 Left palp (ventral), embolic division and supratergular apophysis; 9 Left palp (mesal), embolic division and supratergular apophysis; 10 Left palp, patella (latero-ventral) to show maximum length of apophysis. Abbreviations used: E = embolus, ED = embolic division, SA = supratergular apophysis, TA = terminal apophysis.

#### Measurements of legs (mm) (specimen from Glentress Forest, 27 June 1976):

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.4	0.5	2.3	2.4	1.3	8.9
II	2.1	0.5	2.0	2.0	1.1	7.7
III	1.5	0.4	1.1	1.4	0.6	5.0
IV	1.9	0.4	1.4	1.7	0.9	6.3

*Chelicerae*: Coloured as carapace, sometimes with faint sooty patches on the anterior surface. Outer margin with 3 teeth, inner with 2. *Epigyne*: Figs. 4, 5.

Not unlike those of *Linyphia* (e.g. *L. hortensis* Sundevall).

### Male

*Carapace length*: 1.73 mm. *Total length*: 3.33 mm (probably diminished by shrinking).

The general markings and colouring are as in the females but darker. *Carapace*: With bristles behind the eyes (Fig. 6). *Eyes*: Apparently rather closer to each other than in the females, but had shrunken away from the integument.

### Measurements of legs(mm):—

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.6	0.6	2.8	3.2	(1.5)*	10.7
II	2.4	0.5	2.4	2.6	1.1	9.0
III	1.5	0.4	1.3	1.5	0.7	5.4
IV	2.1	0.5	2.3	2.3	0.9	8.1

\*Segment missing. Estimated from measurement of European specimen.

*Chelicerae*: Anterior surface with many small warts, each carrying a bristle (cf. *Linyphia hortensis* Sundevall). *Male palp*: Figs. 7, 8, 9, 10. This is very distinct and varies little among the species of the genus. The patella bears a long apophysis (Fig. 10) useful in identification. The embolic division is reminiscent of those of *Linyphia* and *Neriere*, but the terminal apophysis has no screw formation.

The specimens have been compared with some *P. phrygianus* (C. L. Koch) from the Koch collection in the British Museum (Natural History) and with some American species, being closest to *P. subarcticus* Chamberlin & Ivie (which however has a relatively

longer patella apophysis). We wish to thank Mr F. Wanless and Mr P. Hillyard for the loan of specimens.

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Young Sitka Spruce (*Picea sitchensis* (Borg.) Carr.) at 8689, more mature Norway and Sitka Spruce at other sites.

Dalby Forest, Yorkshire. CJS, 16 September 77, SE 8689, 9090, 9292. Immature males and females. Habitat as above, but at 9292 mainly larch with some young spruce.

Cropton Forest, Yorkshire. CJS, 14 September 77, SE 7492. Immature females. From pockets of young Sitka Spruce in larger areas of Norway Spruce.

Overton Wood, Yorkshire. CJS, 10 December 77, SE 5457. Subadult male. From Norway Spruce in area also with European Larch (*Larix decidua* Mill.).

Moorlands Nature Reserve, Yorkshire. CJS, 2 January 78, SE 5758. Subadult male. From spruce in a mixed ornamental wood.

Sites where short visits to conifer plantations failed to reveal the species, but where further investigation is needed, are as follows:—

Harwood Forest, Northumberland. NPA, 2 June 77, NY 9691.

Kidland Forest, Northumberland. NPA, 2 June 77, NT 9110. Kershope Forest, Northumberland. NPA, 8 June 77, NY 5083.

Glen Trool Forest, Galloway. NPA, 9 August 77, NX 4079. Tow Hill Nature Reserve, N.W. Yorkshire. CJS, 10 August 77, SD 8286.

Strenshall Common, Yorkshire. CJS, 9 September 77, SE 6659.

Dalby Forest, Yorkshire. CJS, 16 September 77, SE 8585, 8784.

In addition, AQKL and JHS searched unsuccessfully on 17 August 1977, in mixed conifers in the Langdale Forest at SE 963945, about 300 m from the pitfall where the male was obtained in the previous year.

### Ecology

*P. phrygianus* and its congeners must be among the most successful spiders of the boreal conifer forests in both the Old and the New World. They also occur in conifer forests further south, which are there largely restricted to mountains of a moderate height (Wiehle, 1956). An idea of the ecology of *P. phrygianus* in northern regions can be obtained from Palmgren's (1972) careful work near Tvärminne, in southern Finland. Its success there is indicated by the fact that it was one of only nine species (considering the whole range of habitats) represented by more than 1,000 specimens in Palmgren's semi-quantitative collections. As in Britain, however, adult males were scarce (only

11, with 71 females and 958 juveniles).

Palmgren found *P. phrygianus* to be the most common species on the trees in the spruce forest, which in that area approached the natural climax, with many old trees and an almost closed canopy. (The next most abundant species was *Dismodicus elevatus* (C.L.K.), with only one third as many specimens.) *P. phrygianus* was also fairly numerous in pine woods (presumably *Pinus sylvestris* L.) which were on rather drier and poorer soils, but it did not achieve a dominant status there. It was only rarely found on low-growing shrubs such as *Calluna* and in the higher vegetation of bogs. Only a single individual was found in the moss layer on the ground in the spruce forests: Palmgren comments that there is evidently no winter migration to the ground in this species, a fact that accounts for the recent British find of specimens in the trees in December and January.

Similarly, Engelhardt (1958) in his study of the spiders of a spruce plantation in Germany, charac-

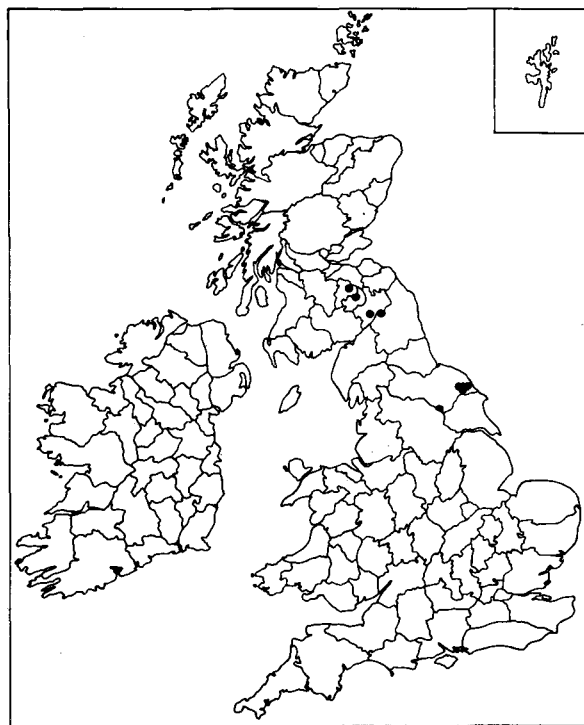


Fig. 1: The known British distribution of *Pityohyphantes phrygianus*.

terised *P. phrygianus* as a species of the canopy. The species was, however, not particularly abundant, forming only 0.4% of the total sample.

It is possible that the North American forms of *Pityohyphantes* are less strictly confined to trees. In Newfoundland Hackman (1954) records *P. costatus* Hentz "...in the herbaceous vegetation and on lower branches of trees" and Kaston (1948, p. 120) referring to a New England population of the same species, writes: "The species builds its webs on fences, shrubs, the lower branches of trees, and on herbaceous plants... I have also taken many of the spiders from the corners of little-used barns, and outhouses."

In Britain *P. phrygianus* seems to be largely restricted to conifer plantations. In the area near the Bridestones Nature Reserve in Yorkshire, where the most intensive work has been done, CJS found only a single individual (the first) in the relict oakwoods (which had a few spruce trees in them) although the species was common in the spruce plantations nearby. Similarly, AQKL, in his samples from one compartment of the Langdale Forest, planted with Corsican Pine with hybrid larch (*Larix decidua* Mill. x *L. leptolepis* (Sieb. & Zucc.) Gord.) on one side, found only a single specimen of *P. phrygianus* (the adult male) among about 8000 adult spiders identified, even though the species is known to be common in spruce plantations within a few kilometres.

Within plantations, *P. phrygianus* has been taken on Norway Spruce, Sitka Spruce and on larch, but in the latter case only in plantations also containing spruce trees.

Where we have studied them in Britain, the sheet or "hammock" webs of *P. phrygianus* are typically slung below a branch at or near the tip, with attachments to the tips of as many as 20 branchlets and sometimes also to the axis of the branch. The sheet is almost flat, but may be inclined at a small angle to the horizontal plane. In our experience the spider is sometimes to be found on the under surface of the web but sometimes at the edge under the shelter of one of the branchlets. Wiehle (1956) says that the hammock-shaped web is about 20 cm long and 10-15 cm wide; we have noted one web larger than this, but it seemed to be really a web-complex, which may have been added to over a substantial period.

The life history of *P. phrygianus* in Britain has not

yet been fully worked out. On the continent Wiehle (1956) and Engelhardt (1958) list May and June as the months of maturity. In Britain adult females have been found in the period late May to early June both in the Borders/Northumberland area and in Yorkshire; a female found on 27 June 1976 near Peebles already had an egg sac. No observations have been made during July, but on 8 August 1977 CJS found adult females at four sites in North Yorkshire, most of them with the abdomen distended. There were also many subadult males and females, some of the males having the incipient knob on the palpal patella indicating that they were in the penultimate instar. In a visit to the area on 16 September, however, no adults were found and the number of juveniles was much lower than in August. CJS also took single subadult males in December 1977 and January 1978. The only adult male found in Britain is still the one obtained by AQKL in a pitfall in the period 4-18 August 1976.

These data, although fragmentary, show that there is little synchrony in development within the British populations. The occurrence of subadult males in midwinter and of adult females in late May and early June implies overwintering of large immatures, and the first clutches are known to be laid by the end of June. However, the observation of females with distended abdomens in early August implies that egg-laying continues into late summer and suggests that some juveniles may overwinter as early instars.

It is worth bearing in mind that if *P. phrygianus* has recently colonized Britain, it has done so from an undetermined part of Europe, probably with a more highly continental climate. Toft (1976) has shown that a high proportion of European woodland spiders show striking differences in life history in different parts of their ranges, so it is likely that the life history of *P. phrygianus* in Britain is undergoing adjustment. Since the species spends the winter in the trees the milder conditions in winter in Britain would tend to promote a longer period of activity and so lead to differences in the time of maturity and the length of the life cycle.

## Discussion

It seems to us likely that *P. phrygianus* is a newcomer to Britain. The fact that the first three observations were made independently in the space of three