# REPLACEMENT OF *BOMBUS MUSCORUM* BY *BOMBUS PASCUORUM* IN NORTHERN BRITAIN?

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**Abstract**

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Records of bumble bees from four collecting trips (1977, 1978, 1988, and 1994) in northern Britain show apparent changes in the incidences of two species. Until 1988, *Bombus muscorum* (Linnaeus) and *Bombus pascuorum* (Scopoli) were found in the counties of Cumbria, Durham, and North Yorkshire. Only *B. muscorum* was found in the Orkney Islands in 1978. In 1994, however, *B. pascuorum* was found abundantly in all of these areas, and in the Orkney Islands we could find only a single *B. muscorum*. From these data, *B. pascuorum* appears to have been replacing *B. muscorum* in some parts of northern Britain.

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**Résumé**

Des specimens de bourdons recueillis lors de quatre voyages (1977, 1978, 1988 et 1994) dans le nord de la Grande Bretagne démontrent, semblerait-il, des changements dans l'occurrence de deux espèces. Jusqu'à 1988 *Bombus muscorum* (Linnaeus) et *Bombus pascuorum* (Scopoli) étaient retrouvées dans les comtés de Cumbria, Durham et North Yorkshire. En 1978, seul *B. muscorum* était retrouvé sur les isles Orkades. En 1994, *B. pascuorum* fut retrouvé abondamment dans toutes ces régions, et sur les isles Orkades nous n'avons trouvé qu'un seul individu de *B. muscorum*. Ces données suggèrent que *B. muscorum* est en voie d'être remplacé par *B. pascuorum* dans quelques regions du nord de la Grande Bretagne.

## Introduction

This paper reports an apparent recent change in the distributions of two bumble bee species of the subgenus *Thoracobombus* in two areas of northern Britain. Below we first describe the distributions of the two species, *Bombus muscorum* (Linnaeus) and *Bombus pascuorum* (Scopoli), as they were known until the mid-1970s, and then the beginnings of a change around that time. The results of a series of bumble bee collections in northern Britain (1977, 1978, 1988, and 1994) provide further evidence for a change in species distributions.

The distribution of the bumble bee species of the British Isles can be seen on a series of maps published by the International Bee Research Association (1980). The various subspecies and their locations, as they were known up to 1974, were described by Alford (1975). In general, *B. muscorum* had a "fringing distribution" (Richards 1935), i.e., they fringed the coasts of the British Isles. *Bombus muscorum* was found on islands offshore of Scotland (the Shetland Islands and the Hebrides, subspecies *smithianus*; the Orkneys, subspecies *orcadensis*), on the Aran Islands offshore of Ire-

land (subspecies *allenellus*), on the Isles of Scilly off Cornwall, and on Alderney in the Channel Islands (subspecies *scyllonius*). It was also found in coastal areas [e.g., the coast of Norfolk (Plowright 1967)] and other parts of the mainland, especially in areas of high elevation and harsh climate (e.g., Cumbria, Durham, and North Yorkshire). In comparison, *B. pascuorum* was present almost everywhere on the mainland of England, Scotland, and Wales, but (until recently, see below) was absent from some of the offshore islands inhabited by *B. muscorum* (Alford 1975).

Between writing and publication of Alford's book (1975), *B. pascuorum* was found on Lundy Island, where it was previously unknown. This new appearance suggested the possibility of an expanding range for *B. pascuorum*. Accordingly, on collecting trips in 1977, 1978, 1988, and 1994 to localities in northern England (Cumbria, Durham, and North Yorkshire) and Scotland (the Orkney Islands), we examined the relative incidences of *B. pascuorum* and *B. muscorum*. These are reported below.

## Methods and Results

Sampling dates fell well within the activity periods for both species. Although sampling effort at various localities could not be completely standardized (e.g., number of individuals observed per unit time was not recorded), we made every attempt to equate sampling effort at the various localities: Wherever either *muscorum* or *pascuorum* were found, at least 20 individuals were observed, not all of which were caught for the collection.

The results of four collecting trips are reported in Table 1. Selected localities in the counties of Cumbria, Durham, and North Yorkshire were visited in each of the 4 years. In 1978 and 1994, records were also obtained for the Orkney Islands and, occasionally, for the Scottish mainland. The records in Table 1 are sorted by species and date. The map coordinates are given as British National Grid references and as latitudes and longitudes read from Ordnance Survey Maps.

Table 1 shows that *B. muscorum* was found in parts of northern England until 1988. *Bombus muscorum* was also found abundantly in the Orkney Islands in 1978, but we could find no *B. pascuorum* at that time. In 1994, however, despite intensive searching, we found no *B. muscorum* at all in Cumbria, Durham, or North Yorkshire, only *B. pascuorum*. On the Orkney Islands, *B. pascuorum* were plentiful, but again, despite intensive searching, only one *B. muscorum* was found (a queen on the Island of Hoy).

## Discussion

To summarize, the change in distributions in those parts of northern Britain which we visited from the 1970s to 1994 is as follows. In parts of northern England, *B. muscorum* was found until 1988, but in 1994 we could find only *B. pascuorum* in those areas. In the Orkney Islands, *B. muscorum* was found on our collection trip in 1978, but *B. pascuorum* appeared to be absent. Then in 1994 we found only *B. pascuorum*, with the exception of a single *B. muscorum* queen on the Island of Hoy. One possible criticism of this study is that "the right areas" were not searched. Note, however, that for some of the records above, the exact same locations were searched from one year to the other. For example, in 1977 both *B. muscorum* and *B. pascuorum* were found in Leadgate, Cumbria, but in 1988 we could only find *B. pascuorum* in Leadgate. The same applies to Raisbeck, near Orton, in Cumbria.

The change in distributions can be seen as an impoverishment of regional species abundance of *B. muscorum* much as that reported by Alford (1975) for *Bombus ruderatus* (F). It can also be seen as a decline in regional species diversity such as that

TABLE 1. *Bombus muscorum* and *Bombus pascuorum* records for collection trips in northern Britain, sorted by year

| Date | Location | County | Ordnance survey grid | Map reference | N[a] | Caste[b] |
|---|---|---|---|---|---|---|
| | | ***Bombus muscorum*** | | | | |
| 27–08–1977 | Dufton | Cumbria | NY 698260 | 54°37'N, 2°28'W | 3 | W |
| 27–08–1977 | Dufton | Cumbria | NY 698260 | 54°37'N, 2°28'W | 1 | Q |
| 28–08–1977 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 4 | W |
| 28–08–1977 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 1 | M |
| 29–08–1977 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 8 | M |
| 29–08–1977 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 14 | W |
| 28–07–1978 | Aikers, S. Ronaldsay | Orkney | ND 456908 | 58°48'N, 2°57'W | 9 | W |
| 28–07–1978 | Swanbister, Orkney mainland | Orkney | HY 348056 | 58°56'N, 3°08'W | 1 | Q |
| 29–07–1978 | Deerness, Orkney mainland | Orkney | HY 563063 | 58°57'N, 2°45'W | 1 | W |
| 29–07–1978 | Skaill, Orkney mainland | Orkney | HY 588066 | 58°57'N, 2°43'W | 1 | Q |
| 02–08–1978 | Nateby | Cumbria | NY 786064 | 54°27'N, 2°20'W | 1 | W |
| 02–08–1978 | Langthwaite | North Yorkshire | NZ 003027 | 54°25'N, 2°00'W | 1 | M |
| 02–08–1978 | Langthwaite | North Yorkshire | NZ 003027 | 54°25'N, 2°00'W | 7 | W |
| 03–08–1978 | Raisbeck, Nr. Orton | Cumbria | NY 642077 | 54°28'N, 2°33'W | 1 | W |
| 16–08–1978 | Newbiggin Common, Middleton-in-Teesdale | Durham | NY 900328 | 54°41'N, 2°09'W | 10 | M |
| 16–08–1978 | Chapel Fell, St. John's Chapel | Durham | NY 865355 | 54°43'N, 2°13'W | 1 | M |
| 16–08–1978 | Newbiggin Common, Middleton-in-Teesdale | Durham | NY 900328 | 54°41'N, 2°09'W | 6 | W |
| 17–08–1978 | Grassholme Reservoir, Lunedale | Durham | NY 923217 | 54°35'N, 2°07'W | 6 | W |
| 17–08–1978 | Dufton | Cumbria | NY 698260 | 54°37'N, 2°28'W | 1 | W |
| 17–08–1978 | Grassholme Reservoir, Lunedale | Durham | NY 923217 | 54°35'N, 2°07'W | 10 | M |
| 04–06–1988 | Grassholme Reservoir, Lunedale | Durham | NY 923217 | 54°35'N, 2°07'W | 1 | Q |
| 05–06–1988 | Grassholme Reservoir, Lunedale | Durham | NY 923217 | 54°35'N, 2°07'W | 2 | Q |
| 09–06–1988 | Wet Sleddale, Nr. Shap | Cumbria | NY 563126 | 54°30'N, 2°40'W | 2 | Q |
| 10–06–1988 | Moorcock Inn | North Yorkshire | SD 797928 | 54°20'N, 2°19'W | 2 | Q |
| 17–06–1988 | Moorcock Inn | North Yorkshire | SD 797928 | 54°20'N, 2°19'W | 4 | Q |
| 07–07–1994 | Lyness, Hoy | Orkney | ND 312947 | 58°50'N, 3°12'W | 1 | Q |
| | | ***Bombus pascuorum*** | | | | |
| 27–08–1977 | Kirkby Thore | Cumbria | NY 651249 | 54°37'N, 2°32'W | 2 | W |
| 28–08–1977 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 3 | W |
| 28–08–1977 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 1 | M |

TABLE 1 (*continued*)

| Date | Location | County | Ordnance survey grid | Map reference | $N^a$ | Caste[b] |
|---|---|---|---|---|---|---|
| 26–07–1978 | Dornoch | Highland | NH 804902 | 57°53'N, 4°01'W | 3 | W |
| 26–07–1978 | Dornoch | Highland | NH 804902 | 57°53'N, 4°01'W | 1 | M |
| 29–07–1978 | Thurso | Highland | ND 104688 | 58°36'N, 3°33'W | 4 | W |
| 30–07–1978 | Loch Loyal | Highland | NC 617480 | 58°24'N, 4°22'W | 1 | W |
| 31–07–1978 | Pitlochry | Tayside | NN 950578 | 56°42'N, 3°43'W | 2 | W |
| 01–08–1978 | Kirkby Thore | Cumbria | NY 651249 | 54°37'N, 2°32'W | 2 | W |
| 02–08–1978 | Whaw | North Yorkshire | NY 982044 | 54°26'N, 2°02'W | 3 | W |
| 02–08–1978 | Langthwaite | North Yorkshire | NZ 003027 | 54°25'N, 2°00'W | 1 | W |
| 03–08–1978 | Raisbeck, Nr. Orton | Cumbria | NY 642077 | 54°28'N, 2°33'W | 1 | W |
| 03–08–1978 | King's Meaburn | Cumbria | NY 616224 | 54°36'N, 2°36'W | 1 | W |
| 03–08–1978 | Great Asby | Cumbria | NY 671121 | 54°30'N, 2°31'W | 7 | W |
| 04–08–1978 | Waitby | Cumbria | NY 752080 | 54°28'N, 2°23'W | 3 | W |
| 05–08–1978 | Nethertown, Nr. Egremont | Cumbria | NX 987081 | 54°27'N, 3°34'W | 2 | M |
| 05–08–1978 | Nethertown, Nr. Egremont | Cumbria | NX 987081 | 54°27'N, 3°34'W | 4 | W |
| 08–08–1978 | Great Asby | Cumbria | NY 671121 | 54°30'N, 2°31'W | 1 | Q |
| 27–08–1978 | Keiss | Highland | ND 345612 | 58°32'N, 3°08'W | 4 | W |
| 04–06–1988 | Grassholme Reservoir, Lunedale | Durham | NY 923217 | 54°35'N, 2°07'W | 1 | Q |
| 05–06–1988 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 2 | Q |
| 05–06–1988 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 6 | Q |
| 05–06–1988 | Maulds Meaburn | Cumbria | NY 641150 | 54°32'N, 2°34'W | 1 | Q |
| 05–06–1988 | Grassholme Reservoir, Lunedale | Durham | NY 923217 | 54°35'N, 2°07'W | 1 | Q |
| 06–06–1988 | Raisbeck, Nr. Orton | Cumbria | NY 642077 | 54°28'N, 2°33'W | 1 | Q |
| 06–06–1988 | Sunbiggin, Nr. Orton | Cumbria | NY 655085 | 54°28'N, 2°32'W | 1 | Q |
| 07–06–1988 | Dalmellington | Strathclyde | NS 485055 | 55°19'N, 4°23'W | 1 | Q |
| 07–06–1988 | Dalmellington | Strathclyde | NS 485055 | 55°19'N, 4°23'W | 1 | W |
| 09–06–1988 | Wet Sleddale, Nr. Shap | Cumbria | NY 563126 | 54°30'N, 2°40'W | 2 | Q |
| 09–06–1988 | Wet Sleddale, Nr. Shap | Cumbria | NY 563126 | 54°30'N, 2°40'W | 1 | W |
| 09–06–1988 | Maulds Meaburn | Cumbria | NY 641150 | 54°32'N, 2°34'W | 1 | Q |
| 10–06–1988 | Moorcock Inn | North Yorkshire | SD 797928 | 54°20'N, 2°19'W | 4 | Q |
| 10–06–1988 | Crosby Ravensworth | Cumbria | NY 598154 | 54°32'N, 2°37'W | 1 | Q |
| 10–06–1988 | Moorcock Inn | North Yorkshire | SD 797928 | 54°29'N, 2°19'W | 1 | Q |
| 11–06–1988 | Crosby Ravensworth | Cumbria | NY 598154 | 54°32'N, 2°37'W | 3 | Q |
| 17–06–1988 | Moorcock Inn | North Yorkshire | SD 797928 | 54°20'N, 2°19'W | 10 | Q |
| 18–06–1988 | Leadgate | Cumbria | NY 699434 | 54°47'N, 2°28'W | 2 | Q |
| 25–06–1988 | Haresceugh Fell | Cumbria | NY 646424 | 54°46'N, 2°33'W | 1 | Q |
| 26–06–1988 | Yewbarrow Hall, Long Sleddale | Cumbria | NY 504024 | 54°25'N, 2°46'W | 1 | W |
| 27–06–1988 | Drigg, Nr. Ravenglass | Cumbria | SD 049986 | 54°22'N, 3°28'W | 2 | W |
| 28–06–1988 | Bolton New Houses, Nr. Wigton | Cumbria | NY 248442 | 43°47'N, 3°10'W | 3 | W |
| 28–06–1988 | Beckfoot, Nr. Silloth | Cumbria | NY 096502 | 54°50'N, 3°24'W | 1 | W |
| 29–06–1994 | Hunderthwaite | Durham | NY 987211 | 54°35'N, 2°01'W | 2 | Q |
| 29–06–1994 | Hunderthwaite | Durham | NY 987211 | 54°35'N, 2°01'W | 4 | W |

TABLE 1. (*concluded*)

| Date | Location | County | Ordnance survey grid | Map reference | $N^a$ | Caste[b] |
|---|---|---|---|---|---|---|
| 30–06–1994 | Seascale | Cumbria | NY 037008 | 54°23'N, 3°29'W | 1 | Q |
| 02–07–1994 | Longmarton | Cumbria | NY 666238 | 54°37'N, 2°31'W | 2 | W |
| 03–07–1994 | Longmarton | Cumbria | NY 666238 | 54°37'N, 2°31'W | 2 | Q |
| 04–07–1994 | Strath Rory | Highland | NH 662777 | 57°46'N, 4°15'W | 3 | Q |
| 06–07–1994 | Windwick, S. Ronaldsay | Orkney | ND 458869 | 58°46'N, 2°57'W | 5 | W |
| 06–07–1994 | Windwick, S. Ronaldsay | Orkney | ND 458869 | 58°46'N, 2°57'W | 2 | Q |
| 06–07–1994 | Crya, Orkney mainland | Orkney | HY 331054 | 58°56'N, 3°10'W | 10 | Q |
| 06–07–1994 | Crya, Orkney mainland | Orkney | HY 331054 | 58°56'N, 3°10'W | 1 | W |
| 07–07–1994 | Linksness, Hoy | Orkney | HY 236045 | 58°55'N, 3°20'W | 12 | Q |
| 07–07–1994 | Bu of Aith, Hoy | Orkney | ND 296894 | 58°46'N, 3°14'W | 3 | Q |
| 08–07–1994 | Broch of Gurness, Orkney mainland | Orkney | HY 386268 | 59°07'N, 3°05'W | 1 | Q |
| 10–07–1994 | Brampton, Nr. Appleby | Cumbria | NY 679233 | 54°36'N, 2°30'W | 2 | W |
| 11–07–1994 | Ribble Head | North Yorkshire | SD 770791 | 54°12'N, 2°21'W | 1 | W |
| 11–07–1994 | Garsdale Common | North Yorkshire | SD 788902 | 54°18'N, 2°20'W | 1 | W |
| 13–07–1994 | Hope Moor, Nr. West Hope | North Yorkshire | NZ 020069 | 54°27'N, 1°58'W | 1 | Q |
| 15–07–1994 | Garrigill | Cumbria | NY 751421 | 54°46'N, 2°23'W | 2 | Q |
| 15–07–1994 | St. John's Chapel | Durham | NY 877377 | 54°44'N, 2°11'W | 4 | W |

[a] Number of individuals.
[b] M, male; Q, queen; W, worker.

reported by Williams (1982, 1989) for central England. Either way, it seems to be a contraction of the range of *B. muscorum*, with a commensurate expansion of the range of *B. pascuorum*; in other words, *B. pascuorum* seems to be replacing *B. muscorum*. This trend is consistent with a previous report by Alford (1975) of *B. pascuorum* appearing on Lundy Island where it was previously unknown. It is also consistent with Prŷs-Jones and Corbet's (1991) noting that *B. muscorum* seems to have recently declined throughout much of its range in Britain. Further monitoring will be needed, however, to determine whether the phenomenon described here is lasting. It may turn out to be cyclic, as in the case of *Bombus lapidarius* (L.), for which the range presently extends north of Aberdeen, Scotland: it had retracted as far as Edinburgh earlier this century, having previously been known as far north as Caithness and Orkney (O. Prŷs-Jones, personal communication, July 1996).

There may be many possible causal explanations, and further work will be needed to distinguish between the processes which may be showing the strongest influence on any changes in the distribution of the bees. One possibility is raised by physiological considerations. *Bombus muscorum* appears to tolerate cold and damp weather conditions and as such is specially suited to northern coastal and offshore areas: queens of *B. muscorum* appear comparatively late in the season, they are on the whole larger than *B. pascuorum*, and their hair is denser (Alford 1975). In other words, in harsh climates, *B. pascuorum* may suffer a competitive disadvantage to *B. muscorum*. Although individuals of *B. pascuorum* may more or less regularly arrive on the Orkney Islands, distribution records from the International Bee Research Association atlas (1980) and our own observations suggest that until recently they did not

persist. We offer, as a very speculative suggestion, that climatic change, possibly global warming, might be implicated, and that *B. pascuorum* has recently moved into areas previously too harsh to inhabit. Northern expansion noted over the same period for two other species, *B. lapidarius* and *Bombus terrestris* (L.) (O. Prŷs-Jones, personal communication, July 1996), supports this interpretation.

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