On the geographic distribution of queen polymorphism in
Myrmecina graminicola (Hymenoptera: Formicidae)

Alfred BUSCHINGER, Birgit C. SCHLICK-STEINER, Florian M. STEINER & Xavier ESPADALER

Abstract
Queen polymorphism, i.e. the occurrence of normally alate/dealate females (gynomorphs) and more or
less workerlike intermorphs, both representing functional queens within one species, has been described
in the ant Myrmecina graminicola. To date, in Europe this phenomenon has been reported only for popu-
lations in southern Germany (S-Hesse and NW-Bavaria), although a few instances of probably inter-
morphic specimens have been mentioned from Switzerland and Italy as well. Here, we report on new data
from Germany (Northrhine-Westfalia), Austria (Carinthia, Styria, Lower Austria), Spain (Tarragona,
Gerona) and Italy (Mantova): Intermorphs were found as functional queens in five regions (Northrhine-
Westfalia, Carinthia, Styria, Lower Austria, Tarragona); in a total of four regions intermorphs were found
along with gynomorphs (Northrhine-Westfalia, Styria, Lower Austria, Tarragona); and in two regions
(Gerona, Mantova), only a few isolated intermorphic specimens were found, demonstrating that this form
occurs there, too. Whether queen polymorphism is a character of the species throughout its range, or
whether it is restricted to certain areas in Europe, remains unknown.

Key words: Formicidae, Myrmecina graminicola, queen polymorphism, geographic distribution,
intermorph, Austria, Germany, Italy, Spain, Europe.

Introduction
The cryptic ant Myrmecina graminicola (LATREILLE,
1802) has a very extended Western Palaeartic distri-
bution range, from northern Africa, Spain, Italy,
Greece and Asia Minor to England and southern Scan-
dinavia (Fig. 1; CZECHOWSKI & al. 2002). Apart
from workers and males, nearly exclusively alate/
dealate females and queens have been reported from
this entire range. Only recently, BUSCHINGER (2001)
and BUSCHINGER & SCHREIBER (2002) described a
queen-polymorphism of M. graminicola in popu-
lations in southern Germany (S-Hesse and NW-Bava-
rria). Along with normal "gynomorphic" females, "in-
termorphs" – always wingless and morphologically
intermediate between workers and gynomorphs –
occur. They can be inseminated and are capable of
becoming functional queens. Remarkable aspects are:
Colonies with gynomorphic queens always are mono-
gynous, while colonies with intermorphic queens are
either monogynous or polygynous. The female sexual
offspring of gynomorphic queens are either gyno-
morphs or intermorphs exclusively, while intermor-
phic queens either produce exclusively intermorphic
female sexuals or both gynomorphs and intermorphs
simultaneously. The queen polymorphism is geneti-
cally based (Buschinger, unpubl.).

To date, the geographic distribution of queen poly-
morphism within the total range of M. graminicola
was unknown. Here, we summarize the current know-
ledge and present the first substantiated records on
intermorphs from Austria, Italy, and Spain.

In this contribution, castes are functionally de-
defined (queen = inseminated and laying eggs, inde-
pendently of its morphological appearance; worker
= more or less sterile, working). The different morphs
are called gynomorphs (= alate/dealate, normal female of ants) and intermorphs (= morphologically intermediate form between gynomorph and ergatomorphic worker). Gynomorphs as well as intermorphs can be inseminated and fertile and can thus function as queens (cf. BUSCHINGER & CROZIER 1987).

Material, Methods and Results

Deliberately finding *M. graminicola* is difficult. Relatively warm and damp sites within sparsely wooded areas, near wood margins and at the foot of wooded hills are the best places. The small nests are frequently located beneath big, often partly mossy stones, which are embedded in the soil to depths of c. 10 - 15 cm (BUSCHINGER & SCHREIBER 2002). The colonies can often be collected whole using an aspirator. Some, perhaps even many colonies, however, live in small chambers in the soil, without adjoining stones. These are only rarely found, except when collected by chance within a soil sample. Such hidden nesting may explain why most publications report only single workers, discovered while digging or caught in pitfall traps.

In the following we list hitherto unpublished records of *Myrmecina graminicola* from seven regions, in Germany (Northrhine-Westfalia), Austria (Carinthia, Styria, Lower Austria), Spain (Tarragona, Gerona), and Italy (Mantova; see also Fig. 1):


(3) Saager vic. Gallizien (14°55'E / 46°56'N; Carinthia), 410 m NN, 17.VI.2003, leg. A. & R. Buschinger, coll. Bu #3.126: nest; 1 egg, 10 workers, 2 larvae. Fostering the larvae in the lab yielded gynomorphic females (along with further workers).


This colony was unusually big. Colonies with several intermorphic queens in S-Hesse/NW-Bavaria contain an average of 57.2 (± 34.3) workers, but a maximum of 136. If a colony is kept in the lab for several years, similarly high numbers of workers can be obtained, however (Buschinger, unpubl.).


(10) Ridge W Förthofgraben vic. Stein an der Donau (15°33'E / 48°24'N; Lower Austria), 430 m NN, 3.IX.2003, leg. B.C. Schlick-Steiner & F.M. Steiner, coll. b&f #12.788 and #12.789: nest; 1 intermorphic queen, 72 workers.


Two further records from the same place exclusively contained workers (48 and 47, respectively).

(14) Cave vic. Sant Feliu de Pallarols (2º30'E / 42º05'N'; Gerona), 453 m NN, 6.XI.1979, leg. X. Bellés, coll. Espadaler: pitfall trap catches; 2 intermorphs.
Fig. 1: Range of *Myrmecina graminicola* in the Western Palaearctic (following CZECHOWSKI & al. 2002, altered), and regions where intermorphs have been found (black dot: substantiated record, black circle: probable record, but without voucher specimen). 1 = Northrhine-Westfalia, 2 = Hesse (BUSCHINGER & SCHREIBER 2002), 3 = Bavaria (BUSCHINGER & SCHREIBER 2002), 4 = Lower Austria, 5 = Styria, 6 = Carinthia, 7 = Mantova, 8 = Gerona, 9 = Tarragona, 10 = Tessin (KUTTER 1916, 1977), 11 = Thuringia (B. Seifert, personal communication1).

(15) La Mussara (1º02'E / 41º15'N; Tarragona), 900 m NN, 23.III.1978, leg. X. Espadaler, coll. Espadaler: nest (incompletely dug out); 3 intermorphs, 3 gynomorphs, some larvae and pupae.


Nest records exist from five regions (Tab. 1, Northrhine-Westfalia, Carinthia, Styria, Lower Austria, Tarragona), and in all of these regions intermorphs were found within nests. In a total of four regions (Northrhine-Westfalia, Styria, Lower Austria, Tarragona) both morphs – intermorphs and gynomorphs – were found. Two regions have currently yielded only a few intermorphs (Gerona, Mantova).

**Discussion**

The above data are the first proof of the presence of intermorphs of *Myrmecina graminicola* for Austria (north of the Alps in Lower Austria, and in Carinthia and Styria) and for Spain (Tarragona, Gerona) (Fig. 1). In addition, the record from Italy is the first substantiated record based on a stored voucher specimen. In some nests in Lower Austria and Styria, the only female sexuals were intermorphs: their slightly extended gaster allows them to be addressed as functional queens. In these populations, colonies with gynomorphic queens were also found. Based on the current knowledge on the biology of *M. graminicola* (BUSCHINGER & SCHREIBER 2002), summarized in

<table>
<thead>
<tr>
<th>Region</th>
<th>Nests</th>
<th>with gynomorphs</th>
<th>with intermorphs</th>
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<tr>
<td>Northrhine-Westfalia</td>
<td>2</td>
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<td>1</td>
</tr>
<tr>
<td>Carinthia</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Styria</td>
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<td>1</td>
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</tr>
<tr>
<td>Lower Austria</td>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Tarragona</td>
<td>1</td>
<td>1</td>
<td>1</td>
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Tab. 1: Nest records of *Myrmecina graminicola* in the studied regions, with the occurrence of intermorphs and gynomorphs (n = number of nests per region).

1 Communicated while the article was in press.
the introduction, the occurrence of 3 intermorphs and 3 gynomorphs within one nest in Tarragona indicates that one or several intermorph(s) was/were the functional queen(s) of this nest and the gynomorphs were probably virgin offspring. In this region, however, gynomorphs, due to the few available samples, were not found as functional queens. Thus, in Austria a queen polymorphism in the species, as it had been demonstrated for southern Germany (BUSCHINGER & SCHREIBER 2002; S-Hesse and NW-Bavaria), was proved, for Spain it is highly probable. The records from Bonn-Bad Godesberg show that this polymorphism also exists in Northrhine-Westfalia.

Myrmecina kutteri FOREL, 1915 was described from Tessin, Switzerland (KUTTER 1916). Interpreting the respective figure in KUTTER (1977, fig. 166) according to our definition, this taxon probably refers to intermorphs. A further specimen in KUTTER (1977, fig. 167, "microgyne") is definitely an intermorph. According to BROWN (1951) synonymised fig. 167, “microgyne”) is definitely an intermorph. Further study is needed to address the issue of whether queen polymorphism occurs within the entire range of Myrmecina graminicola or whether it is restricted to some areas. Only then will we be able to determine whether climatic or other ecological factors trigger the evolution of such queen polymorphism.

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References

Zusammenfassung
Königinnenpolymorphismus, also das Auftreten von normalerweise ge- oder entflügelten Weibchen (Gynomorphen) und von mehr oder weniger arbeiterrähnlichen Intermorphen, beides funktionelle Königinnen innerhalb einer Art, wurde vor kurzem für die Ameisenart Myrmecina graminicola beschrieben. Bisher war dieses Phänomen innerhalb von Europa nur für Populationen in Süddeutschland (S-Hessen und NW-Bayern) bekannt, obwohl vereinzelt Hinweise auf wahrscheinlich intermorphe Individuen in der Schweiz und in Italien in der Literatur existieren. Wir präsentieren hier neue Daten aus Deutschland (Nordrhein-Westfalen), Österreich (Kärnten, Niederösterreich), Spanien (Tarragona, Gerona) und Italien (Mantova): Intermorphie wurden als funktionelle Königinnen in fünf Regionen festgestellt (Nordrhein-Westfalen, Kärnten, Steiermark, Niederösterreich, Tarragona). In insgesamt vier Regionen wurden sowohl Intermorphie als auch Gynomorphe angetroffen (Nordrhein-Westfalen, Steiermark, Niederösterreich, Tarragona). Aus zwei Regionen (Gerona, Mantova) liegen ausschließlich Funde vereinzelter intermorpher Individuen vor, was zeigt, dass diese Form dort ebenfalls vorkommt. Ungewöhnlich bleibt, ob der Königinnenpolymorphismus im gesamten Verbreitungsgebiet der Art vorkommt, oder auf bestimmte Gebiete Europas beschränkt ist.


