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A Method for Differentiation of the Female Castes of *Tapinoma ambiguum* EMERY and *Tapinoma erraticum* (LATR.) and Remarks on Their Distribution in Europe North of the Mediterranean Region

(Insecta, Hymenoptera, Formicidae)

With 9 Figures

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Introduction

Tapinoma ambiguum described for the first time as *T. erraticum* (LATR.) v. *ambigua* by EMERY in 1925 has been ignored by many European myrmecologists up to the present, regardless of the striking differences in male genitalia which were stated in EMERY's original description. Since males provided the only secure method for differentiation from *T. erraticum* (LATR.) till now records on occurrence of *T. ambiguum* were restricted by the rare findings of this caste. The ignorance of *T. ambiguum* by some authors, together with the custom of others to name the found female castes always as *T. erraticum*, produced the biased, misleading picture that the latter was much more abundant. Only PISARSKI (1975) and KUTTER (1977) expressed critical, cautious opinions. This paper will demonstrate that we have a rather simple and satisfactorily secure method for determination of workers and queens. I was prompted to make a more profound study of this problem by a suggestion of B. PISARSKI that both species probably could be separated using the depth of clypeal incision (L. GALLÉ, personal communication 1980).

Material

T. ambiguum: 12 males from GDR and FRG (Thüringen, Nordharzvorland, Schwarzwald), and from Hungary (Bugac-Pusztá); 40 queens from GDR, FRG, Poland, Spain, Hungary, Bulgaria; appr. 300 workers from GDR, FRG, Poland, Czechoslovakia, Bulgaria, Romania, and England.

T. erraticum: 8 males from France (Landes), Switzerland (Vaux near Morges), GDR (Thüringen), FRG (Schwarzwald), and southern England; 28 queens from GDR, FRG, Switzerland, France, Hungary, Spain, Bulgaria; appr. 300 workers from GDR, FRG, Switzerland, France, Hungary, Bulgaria, and southern England.

The material used in this paper belongs mainly to the following collections: Staatliches Museum für Naturkunde Görlitz, Zoologisches Museum Berlin, Staatliches Museum für Tierkunde Dresden, Abteilung Taxonomie der Insekten des Institutes für Pflanzenschutzforschung Eberswalde. I wish to express my grateful thanks to Cedric COLLINGWOOD/Skipton, Laszlo GALLÉ/Segez, and Klaus LIPPOLD/Leipzig for providing specimens for this study.

Results of morphological investigations

Males:

The distinction of our two species in this caste was always clear, in spite of some variability, and no further comment is necessary. The typical shape of genitalia which normally can be

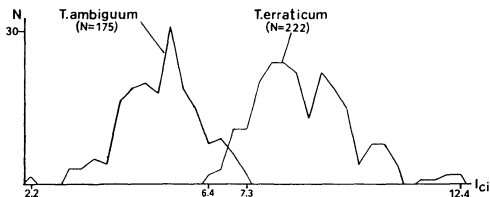


Fig. 1. Index of clypeal incision of 397 workers of *Tapinoma ambiguum* et *erraticum* from Europe north of the Mediterranean region showing minimal overlap between the two species (13%).

observed easily in dry specimens is illustrated by figs. 3 and 5. Additionally, the *T. ambiguum* male differs from *T. erraticum* in having other shape and smaller size of head, and much shallower or absent clypeal cleft. Because of the definite genitalia characters I have resigned to make a statistics.

Queens:

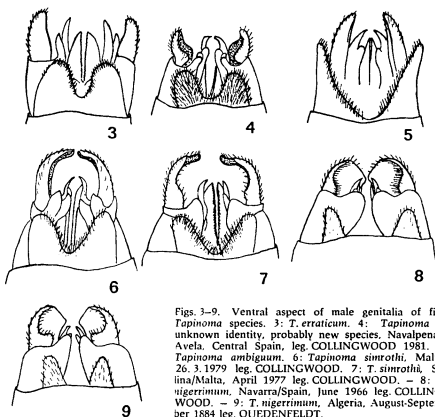
The measurements were taken under use of a SM XX stereomicroscope of Carl Zeiss Jena. The clypeal incision was measured in its maximum depth in dorsofrontal adjustment of head at a magnification of 200. All metric values are expressed in micron, although such accuracy is not achieved at magnifications lower than 200. The following table gives the results of measurements where H_w = maximum head width and I_{ci} = index of clypeal incision which is the maximum depth of clypeal incision expressed as per cent of H_w . Given are the arithmetic mean, standard deviation, the number of examined specimens and, in square brackets, the total interval of data.

<i>T. ambiguum</i>		<i>T. erraticum</i>	
H_w	895.6 ± 36.6 (n = 40) [813, 956]	980 ± 39.4 (n = 28) [903, 1040]	
I_{ci}	4.92 ± 0.75 (n = 39) [3.0, 6.3]	7.93 ± 0.85 (n = 28) [6.5, 8.8] [6.5, 10.1]	excluding Bulgarian queens including Bulgarian queens

The data show a very well distinction of queens by the I_{ci} . In many cases H_w may be used for separation: 50% of the *T. ambiguum* and 71% of the *T. erraticum* queens had values outside the overlap range. The I_{ci} showed no significant correlation to head width for both species.



Fig. 2. Variation of clypeal cleft shape in *T. ambiguum* (upper drawings) and *T. erraticum* (drawings below), and mode of measuring its depth.



Figs. 3-9. Ventral aspect of male genitalia of five *Tapinoma* species. 3: *T. erraticum*. 4: *Tapinoma* of unknown identity, probably new species, Navalpenas/Avela, Central Spain, leg. COLLINGWOOD 1981. 5: *Tapinoma ambiguum*. 6: *Tapinoma simrothi*, Malta, 26. 3. 1979 leg. COLLINGWOOD. 7: *T. simrothi*, Salina/Malta, April 1977 leg. COLLINGWOOD. - 8: *T. nigerrimum*, Navarra/Spain, June 1966 leg. COLLINGWOOD. - 9: *T. nigerrimum*, Algeria, August-September 1884 leg. QUEDENFELDT.

Workers:

The measurements were taken as described above. I resigned to take up into the statistic study material of both species from Mediterranean countries like Spain, Malta, Algeria, Libanon, Syria, Portugal, and Greece because I was not always able to distinguish them from other *Tapinoma* species we have to expect in this region. For brief remarks to the complicated *Tapinoma* situation in the Mediterranean fauna see the last section of this paper. The following table gives the morphometric data with abbreviations having the same meaning as above.

<i>T. ambiguum</i>		<i>T. erraticum</i>	
H_w	627.5 ± 75.9 (n = 100) [488, 844]	696.3 ± 87.5 (n = 152) [510, 907]	
I_{ci}	5.25 ± 0.8^a (n = 175) [2.3, 7.01] without Bulgaria [2.3, 7.36] including Bulgaria	8.67 ± 1.15 (n = 222) [6.3-11.0] without Bulgaria [6.3-12.5] including Bulgaria	

H_w is of no use for determination of single individuals in this caste although the statistic separation is perfectly clear. The mean values differ, if tested in a "double t-test", for highest significance levels ($p < 0.001$). A secure character for separation of both species is the I_{ci} . About 87% of the specimens of each species have values outside the overlap range of 6.3 to 7.4. This means a sample of only five workers per nest should always enable a definite decision. This proves true also in the Bulgarian populations where the I_{ci} is on average

higher in *T. ambiguum* (mean = 5.95, $n = 20$) as well as in *T. erraticum* (mean = 9.10, $n = 54$). I_{ci} can be described as function of H_w with

$$I_{ci} = -0.0027 H_w + 10.348 \quad (p < 0.05) \text{ for } T. \textit{erraticum} \text{ and} \\ I_{ci} = -0.0001 H_w + 5.127 \text{ (not significant) for } T. \textit{ambiguum}.$$

The distribution of the I_{ci} values is shown in fig. 1. The shape of clypeal incision, although considerably varying, is regularly a useful additional character for distinction, Fig. 2 illustrates its variability and the mode of measuring its depth.

Remarks on ecology and geographical distribution

I consider now the distribution of both species in Europe except the Mediterranean region as it appears to be from the studied material. For reasons mentioned at the beginning records from literature are not reliable and can not be used. This is the case, for instance, in respect of the Baltic Sea islands Gotland and Öland which are the most northern sites in Europe (about 57 degrees northern latitude) where *Tapinoma* is found. In order to avoid a biased picture of abundance relations in favour of *T. ambiguum* I exclude also from consideration the literature records of this species (e.g. KUTTER, 1977; STITZ, 1939; PISARSKI, 1975) which can be believed as sure.

The restriction on studied material only yielded a total of 33 sites for *T. ambiguum* and of 40 sites for *T. erraticum*. This ratio corrigates the obsolete picture that *T. erraticum* should be the much more common species. The mean position of all sites where *T. ambiguum* was found is 49.3° northern latitude whereas for *T. erraticum* are calculated 46.6°. 15% of the *T. ambiguum* sites against 31% of *T. erraticum* sites were situated southwards of the 45th degree. In Bulgaria both species may occur together at altitudes of 1600 meters (Pirin Mountains, Rhodopes), but *T. erraticum* predominates apparently clearly in the lowlands (e.g. Black Sea coast), a fact that would confirm the picture of horizontal distribution.

The question whether there exist differences in habitat preference is very unclear. At least one of the two species was present on 16 test plots I have examined among others in the course of ecological field investigations in the GDR. *T. ambiguum* occurred on 10 of these test plots and *T. erraticum* was observed on 8 such areas. Both species seem to have very similar demands for environmental factors like soil temperature, soil humidity, and above ground phytodensity. However, the material is poor and the ecological relations remain to be studied more intensively. The fact that *T. erraticum* and *T. ambiguum* coexisted on only two the 16 areas suggests to a strong competition with a tendency for mutual exclusion.

Remarks on the *Tapinoma* species of the Mediterranean fauna

I am not able to make a revision of the Western Palearctic members of this genus including the Mediterranean region at the present stage, but from material I could study I feel necessity to give a short comment. BARONI URBANI (1969) regards all members of *Tapinoma* distributed in Italy, Sardinia, Corsica, Malta, and other islands of the Central Mediterranean to belong to one species, except the minute *T. pygmaeum* (DUFUR). It is obvious that he has synonymised *T. nigerrimum* NYLANDER and *T. simrothi* KRAUSSE which are very common all over the Mediterranean with *T. erraticum* (LATR.). This radical opinion does not meet the complicated situation we find there. In fact the number of species we may expect for the whole Mediterranean fauna is seven, at least, with *T. erraticum*, *T. simrothi*, *T. nigerrimum*, *T. ambiguum*, *T. pygmaeum*, and two other not yet identified species that I could examine which surely not belong to the five others. Apart from this, I believe that further research will bring to light some other unknown crypto species.

Only to illustrate this complicated multiplicity, there are given some drawings of male genitalia (figs. 3–9) of five species from which I had the opportunity to examine males. Fig. 4 shows the genitalia of a probably unknown species from Navalpenas/Avela, Central Spain, leg. COLLINGWOOD 1981. It was collected on a river bank from a colony of medium size containing workers similar to *T. ambiguum*. It remains obscure whether the males in figs. 6 and 7 belong to one species because I have only restricted informations on the total variability and possible occurrence of transitional forms.

Summary

The relative depth of clypeal incision in respect to maximum head width (I_{ci}) is shown to be a very feasible means for separation of female castes of *Tapinoma ambiguum* EMERY and *Tapinoma erraticum* (LATR.). Workers with mean I_{ci} of lower than 6.3 % belong to *T. ambiguum* and those with more than 7.3 % to *T. erraticum*. Queens are well distinguished in single individuals by I_{ci} values of lower than 6.4 (*ambiguum*) or higher than 6.4 (*erraticum*), and often head width is useful. Both species are distributed all over Europe northwards to 53th degree northern latitude, with *T. ambiguum* apparently being the more northern species. The ecological segregation of the two species is obscure. A brief remark to the Mediterranean allies is given assuming a larger number of different species than known till now.

Zusammenfassung

EINE METHODE ZUR UNTERSCHIEDUNG DER WEIBLICHEN KASTEN VON *TAPINOMA AMBIGUUM* EMERY UND *TAPINOMA ERRATICUM* (LATR.) SOWIE BEMERKUNGEN ÜBER IHRE VERBREITUNG IN EUROPA NÖRDLICH DER MEDITERRANEN REGION

Es wird gezeigt, daß die bisher nicht durchgeführte Unterscheidung der weiblichen Kasten von *Tapinoma ambiguum* EMERY und *Tapinoma erraticum* (LATR.) mittels der Tiefe des Clypealeinschnittes relativ zur maximalen Kopfbreite (I_{ci}) sehr gut möglich ist. Arbeiter mit mittleren I_{ci} von unter 6,3 % gehören zu *T. ambiguum* und solche mit mehr als 7,3 % zu *T. erraticum*. Die Königinnen können recht leicht auch in Einzeltieren durch die I_{ci} -Werte unterschieden werden, wobei *T. ambiguum* Werte von weniger und *T. erraticum* Werte von mehr als 6,4 % aufweisen. Auch die Kopfbreite ist für die Unterscheidung der Königinnen häufig brauchbar. Beide Arten sind über ganz Europa nordwärts bis zum 53. Breitengrad verbreitet, wobei *T. ambiguum* offensichtlich die mehr nördlichere Art ist. Die ökologische Abtrennung beider Arten ist unklar. In einer kurzen Bemerkung zu den mediterranen *Tapinoma*-Arten wird die Existenz einer größeren Zahl von Arten postuliert als bisher bekannt ist.

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